Multi-media Instructional Systems in Adult Education,
with special reference to Information Retrieval from
Textbooks

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I hereby declare this thesis to have been composed by myself and to be my own work.
INTRODUCTION

1.1 Summary
1.2 Rationale for the Inquiry
1.3 Relationship between Parts One and Two
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INTRODUCTION

I.1 Summary

The purpose of this study is to analyse the concept of information in instructional systems for adults, outlining the implications of this analysis for the design and use of textbooks as information stores, and formulating hypotheses for further, experimental research. A context for this analysis is provided by a preliminary examination of the systems approach in adult education, which is seen as an attempt to provide a framework for educational innovations which may stem from the introduction of new media.

The new media of radio and television are used both as media of mass communication and as teaching devices in formal education. A review of opinions expressed by adult educators suggests that assumptions about the first of these uses have influenced the second. However, research has shown that in both mass communication and formal instruction, factors other than the medium are important. It is argued that approaches to course development based solely on the notion of utilizing the new media are likely to underestimate important factors relating to the instructional setting, the message or content, and the audience. It is further argued that the new media cannot always be thought of as aids to the teacher or tutor, since in some cases they act as independent teaching agents. However, a problem-based approach, which considers the allocation of all resources, human and material, in the light of the needs of each teaching situation, provides a framework for the use of the new media.
This leads to the design of instructional systems which take into account teaching objectives, methods, materials, media and techniques of evaluation.

Within such an instructional system, an information retrieval system represents a limited devolution of control to the learner, thus constituting a learner-controlled subsystem. In communication terms, an information retrieval system is a receiver-controlled communication system, in contrast to the mass media which have high source-control.

The medium of print, in the form of textbooks, provides an example of a device which can be either source-controlled or receiver-controlled. In the first case, the learner follows the sequence of instruction devised by the source by reading the book from beginning to end in serial order; in the second instance, he uses retrieval devices such as the index, table of contents, and headings to devise his own sequence, thus controlling the information he receives. This second use of textbooks has not been formally investigated in the light of information retrieval theory. It is suggested that this lack of research may be due to a theoretical confusion between describing information as an entity and as a process.

Information viewed as an entity has limiting connotations in an educational context; viewed as a process, it provides guidelines for the design of textbooks for retrieval, and a conceptual framework for formulating testable hypotheses about retrieval.

An outline for the design of textbooks as information stores is given which derives from an analysis of the retrieval process.
In addition, a number of new retrieval devices are suggested, and the possibility of sequencing the text in non-linear order is investigated. Examples of retrieval devices from existing textbooks show a variety of possibilities, but no evidence of the conscious design of retrieval systems. Suggestions are made for a series of experiments which would test the effectiveness of a number of devices. The relevance of the concepts and models of the information retrieval process to formal instruction is argued, provided that retrieval systems are seen as subsystems of the larger instructional system.

1.2 Rationale for the Inquiry

There are both theoretical and practical reasons for pursuing this line of enquiry.

There appears to be some confusion surrounding the concept of information in an educational context, which is evident in some passages quoted in Chapter Three\(^1,2\). This confusion results from a failure to distinguish between attempts to conceptualise information as an entity, and attempts to describe the process of information retrieval. Information as an entity tends to connote facts; thus it is assumed that a learner who is engaged in the process of retrieval is necessarily retrieving factual information. However, it can be argued, following Meadow\(^3\), that the process of retrieval is relatively independent of the type of information retrieved. This means that retrieval systems
may have a much wider usefulness in formal education than has been thought, since they are not confined to handling information of the factual type. They can be seen instead as a communication mode in which the learner has a high degree of control over the sequencing and scope of information. Neither educational technologists, nor retrieval theorists have paid much attention to this problem.

The practical result of this has been haphazard design of textbooks as information stores, as opposed to sequences, and an almost complete absence of research into the design or use of textbooks for retrieval. The experiments which have been reported in Chapter Four do not conceptualise the process in terms of information retrieval. Inquiries from educational publishers have produced few books which evidence of conscious design for retrieval. The overriding impression gained from both the literature on the subject, the examination of existing texts, and the inquiries from a number of specialists in information retrieval, education and publishing, is that the problem has hardly yet been perceived. The task here has therefore been first to clarify the theoretical problem (Chapter Three) and then to pursue the implications of this in practice (Chapters Six to Nine).

Certain advantages could result from better textbook design. It is arguable that if adults can control their own sequencing, they will be able to integrate new knowledge with previous experience more easily than if they are following
someone else's sequence. There is evidence that adults bring a good deal of existing knowledge to almost any new learning situation; this can act either as a bridge, or as an obstacle. There is also some evidence to show that increased learner control of sequencing can result in increased motivation, though this may vary according to personality. A textbook which provides both a serial order and the retrieval devices which permit the learner to individualize his own sequence, allows the learner to exercise just as much control as he wants. The ability to search for and select information can be seen as a useful general skill for adults, which might be learned from the use of information retrieval systems in formal education. The possible advantages of developing the use of retrieval systems in education are therefore both short-term, in the form of increased learning and motivation over a single course, and long-term, in that learning to retrieve information can be considered one aspect of learning how to learn.

1.3 Relationship between Parts One and Two

This study takes the form of a specific investigation (Part Two) placed in the context of a more general one (Part One). This approach was adopted because it was felt desirable to place the detailed analysis of the concept of information and the design of textbooks as information stores in the broader contexts of the communication process and the instructional system.
Meadow\textsuperscript{4} identifies information storage and retrieval as a subtype of the general communication process. Since the emphasis in this thesis is on the process, rather than the content of information retrieval systems, it was felt that a description of the general communication process (see Chapter One) would provide a useful basis for the later analysis, which makes use of communications terms such as 'source' and 'receiver'. Although communications, as described in the first chapter, can hardly be regarded as a unified discipline, it has, as Ely\textsuperscript{5} points out, provided an orientation for some workers in educational technology, which is distinguishable from that provided by educational psychology, programmed learning or the audiovisual movement.

Secondly, it has seemed necessary to describe information retrieval systems as subsystems of the larger instructional system. Ohlinger\textsuperscript{6} reports a good deal of literature on the use of mass media in adult education, but very little as yet on the systems approach. The first two chapters in this thesis cover this transition from what is called here a 'media-based' approach, where the basic notion is that the new media should be utilised, to the systems approach, which places media along with all other resources in a wider context of objectives, methods and evaluation. The discussion of the systems approach in adult education here is necessarily brief by comparison with what could be done, but in the absence of previous work on this subject, it
was felt that some such framework should be established. The danger of examining information systems in adult education without first establishing the instructional systems context is that the former will be treated in isolation and without reference to instructional objectives. Under the influence of a burgeoning information technology, there is already some evidence that the distinction between education and information is being blurred, and the consequent possibility that information retrieval may take its place, temporarily, in the parade of new devices and techniques which have been thought to be educational panaceas. By placing information retrieval systems firmly in a wider instructional context, it is hoped that this can be avoided.

1.4 Method

This analysis is seen as a necessary prelude to experimental work, which is outlined in a final chapter. The task here has been to develop a conceptual framework which will allow testable hypotheses to be formulated. To this end, much of the time has been spent on the analysis of terms like 'medium', 'aid' and 'information'. This is a semantic approach, and has been described by Kneller in the following terms:

It follows that, if we are to understand the problems, policies, and concepts of education, we must first examine carefully the language of educational discourse. The informal analyst does not propose that we purify this language, let alone replace it. His sole stipulation is that we learn to use language properly, which means respecting the informal logic
of words and expressions in education and elsewhere, since meaning of a word or phrase, and hence the inferences we can draw with its help, varies according to context.

Kneller's point about the varying contexts of words used in educational discourse is especially relevant to this study, since some of the key terms under discussion have been transferred to an educational context from other contexts. This is the case with the terms 'medium' and 'information'. Some of the advantages and difficulties of making such transfers have been touched on in the last chapter. In addition to the analysis of terms and concepts, relevant research on textbooks and learner control of sequencing has also been analysed, and textual analysis of a number of existing textbooks is made in Chapter Seven. This analysis consists of the examination of retrieval devices in the books in the light of a rationale worked out in the previous chapter.

1.5 Sources

The treatment of the subjects covered in the first part is not intended to be exhaustive; there is room for much more research on both the relationship between the mass media and adult education and the systems approach in adult education. The aim here has been to investigate these subjects in enough depth to provide a context for the detailed investigation in the second part.

There is a good deal of literature relevant to the first chapter, and reviews by Ohliger and Halloran have proved
useful. Trenaman's\textsuperscript{12} work is central. Ohliger\textsuperscript{13} notes the paucity of literature on the print medium and also reports little as yet on the systems approach. Thus most of the sources for the second chapter have been drawn with appropriate reservations from the growing literature on the systems approach in higher and secondary education. Here, books by Saettler,\textsuperscript{14} Rossi and Biddle,\textsuperscript{15} Weisgerber,\textsuperscript{16} and Knirk and Childs\textsuperscript{17} have been the major sources. Much of the literature has appeared in unpublished reports and papers.

Apart from works entirely concerned with information retrieval theory, of which a few introductory items in a vast literature have been used,\textsuperscript{18,19} there is little to report in the second section. One essay by Paisley and Parker,\textsuperscript{20} a paper by Mager\textsuperscript{21} and a recent book by Horn\textsuperscript{22} are the most relevant sources.

General reading for the study covered books and journals in educational psychology, communications, adult education, educational technology and information retrieval. Much of the reading in the first two of these subjects was of little final use, and the extensive literature on automated information retrieval has not been broached. Use has been made of specialised collections on adult education at the Department of Adult Education, University of Edinburgh, and educational technology at the Centre for Educational Technology, University of Sussex.
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1.6 Organisation

The following notes on the organisation of the thesis may be useful.

As well as the general table of contents at the beginning of the thesis, specific tables can be found at the start of each chapter. These list the sections within each chapter, each of which begins in the text with an underlined heading and a section number.

The reader can also consult structural tables for the thesis and individual chapters in Chapter Eight; the construction of these tables is explained in that chapter.

Lists of references are given at the end of each chapter. These, and other bibliographical items, are collected alphabetically by author at the end of the thesis.

The thesis is divided into two main parts. The first of these deals with the use of new media in adult education, and the reasons for adopting the systems approach.
The reader who wishes to relate the study primarily to adult education and the systems approach should start at the beginning. The analysis of the concept of information comes in Chapter Three, which is another possible starting point. Examples of retrieval devices in textbooks are given in Chapter Seven, and the design of textbooks for retrieval is discussed in Chapter Six. Chapters Eight and Nine are devoted to the investigation of structural tables, and of non-linear texts, respectively. The final chapter contains conclusions of both a general and specific nature, with suggestions for further research.
References to Introduction


4. Ibid., pp.3-8.


10. OHLIGER, J., op.cit.

11. HALLORAN, J.D., Mass Communication Research and Adult Education (Leicester, 1968).


13. OHLIGER, J., op.cit.


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PART ONE

INSTRUCTIONAL SYSTEMS IN ADULT EDUCATION
CHAPTER ONE

ADULT EDUCATION AND THE MASS MEDIA

1.1 Definitions
1.2 Adult Education
1.3 The Mass Media
1.4 The Dual Role of the Media

2 Approaches to the Study of Communications

3.1 The Content and Effects of Mass Communications: the Literary View
3.2 The Effects of Mass Communications: Scientific Study
3.3 Mass Communications and Adult Education: some attitudes

4.1 The Mass Media in Adult Education
4.2 The Mass Media in Adult Education: Effectiveness
4.3 The Mass Media in Adult Education: Reasons for use
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5.1 Adult Education and The Mass Media
5.2 The Concept of a Medium
5.3 The Media-based Approach
CHAPTER ONE

ADULT EDUCATION AND THE MASS MEDIA

1.1 Definitions

Since the terms 'adult education' and 'the mass media' can vary in scope, it is necessary to define them as they will be used in this chapter and the rest of the thesis. These definitions are not being advanced as solutions to the undoubted problems of delimiting these concepts, but merely as scope notes which should help to avoid ambiguity in this particular study.

1.2 Adult Education

The difficulty, even impossibility, of arriving at a satisfactory definition of adult education has been noted by Verner and Booth, Prosser, writing with particular reference to developing countries, lists a large number of apparently dissimilar activities which can claim to be adult education. Lowe, writing about England and Wales, distinguishes between 'adult education' and 'the education of adults'; the former having a more restricted sense, excluding vocational and technical education. The Postgraduate Diploma courses in Adult Education and in Community Development at the University of Edinburgh have common elements; and the distinction between tertiary education, including universities, technical colleges, colleges of education and polytechnics, and adult education, understood as educational provision beyond and after the formal school provision, is becoming increasingly difficult to draw.
An historical perspective on the subject, such as provided by Kelly, reinforces Verner's contention that 'the perception of need and the resultant forms of adult education change from one era to another'. Geographically, the forms that adult education takes vary greatly from the developed to the developing world, and from one country to another. In content, in clientele, and in the institutions that provide it, adult education appears to be incurably heterogeneous.

Faced with this problem, the writer who wishes to find some way of defining the field can either adopt a definition which covers only a certain part of the field, or look for the unifying element in something other than aims, content and institutions. The drawback to the first of these alternatives is that it can lead to partisanship which may polarise in the form of debates about liberal versus vocational education, or formal versus informal, which can have a divisive or impoverishing effect on the field as a whole. Lowe considers that the restricted scope of adult education as defined in the 1919 report, has caused semantic confusion and led to a deplorable neglect of the education of adults as a whole.

The drawback to the second option is that any unifying concepts which can be found must be of an extremely general nature if they are to embrace all the adult education activities which exist.

Verner, however, does point to one common characteristic of all adult education. He distinguishes between two settings
in which adults learn. The first of these is relatively unplanned:

Adults may learn from their natural societal setting—everyday experiences in living, whether at work or at leisure. Adults can learn by reading, by watching television, from conversation, or by participation in the life of the community. By and large, however, such activities produce learning largely by chance or by accident. While everyday activities may provide unparalleled opportunities, the learning achieved thereby is casual and undirected as well as inefficient and uncertain.9 (author's italics)

It is, he argues the second setting which can properly be called adult education. Here, the organisation of learning is conscious and planned:

The second setting in which learning by adults occurs is the formal instructional setting, in which the element of chance is minimized. This setting comes into being when an educational agent designs a sequence of tasks using specific learning procedures to help an adult achieve a mutually agreeable learning objective. This is adult education.......

....Whatever the form, content, duration, physical setting, or sponsorship, an activity is identified as adult education when it is part of a systematic, planned, instructional program for adults. 10 (author's italics)

Verner's emphasis on the systematic and planned nature of adult education is in line with the emphasis on the systematic design and development of courses in this thesis, and his definition will be taken as the key one. Similarly, the unit for discussion will mainly be the program, or course as defined above ('This setting comes into being...'). This might be a course of evening classes lasting a term or several terms, such as those organised by university extramural departments and the W.E.A., industrial training courses,
correspondence courses, or multi-media courses of the type that the Open University will provide. There is no limit placed on either the content or the duration of the courses envisaged, although most of the examples have been taken from formal academic settings. Verner's distinction between the two learning situations provides a unifying concept for adult education by distinguishing it from all other adult activities in which learning takes place. The essence of adult education is held to be its systematic nature; the content is irrelevant to this. The problem of deciding between priorities remains however, and in this form the debate about liberal and technical education can continue. It is now seen as a debate not about the nature of adult education, but about priorities within it. Since this thesis is concerned mainly with the means of implementing educational objectives once they have been decided, this debate, which is about ends, will not be examined. Only insofar as the educational means — the methods and media used in course design — may distort or otherwise affect the ends, will value questions appear.

Having defined 'education' for the purpose of this work, it now remains to define 'adult'. Since this does not directly affect most of the discussion, Jensen's general definition will be adopted:

For the purposes of adult education, at least, we can say, therefore, that an adult is a person who has come into that stage of life in which he has assumed responsibility for himself and usually for others, and who has concomitantly accepted a functionally productive role in his community.
As noted above, the distinction between higher and adult education is sometimes difficult to draw, and much of the content of the second part of this study might apply equally to higher education.

1.2 The Mass Media

Rossi and Biddle define a medium as 'any form of device or equipment which is normally used to transmit information between persons'. They include under this definition 'radio, television, newspapers, billboards, letters, handbills, books, teaching machines'. The apparent simplicity of this definition is belied by an inconsistency in the list of examples they give. The electronic media of radio and television are cited without any qualification, but the print medium, which is also a device for transmitting information between persons, is divided into various forms and formats — newspapers, billboards, handbills and books. This point becomes important when the authors attempt to define the mass media, for while radio and television are treated as single media, print is differentiated:

Media that have a really wide spread are commonly called mass media, the best examples being television, radio, newspapers, nationally circulated magazines, and commercial motion pictures. Intrinsic characteristics of mass media are those of strong communicator and little user control, low cost to the user, and wide spread of use among the user population. Ohliger also refers to print media, in the plural (print media). Trenaman, on the other hand, treats the print medium as a whole:
The medium of communication limits or selects from the symbols. Printing can only transmit printed words. Sound broadcasting can only transmit speech and noises. Television can transmit speech, noises, and limited representations of visual images.

MacLean asserts that television also can be differentiated:

Television, one must reiterate, is not a single medium. It can represent the lightest of light entertainment; it can compete with the qualities of serious journalism; it can also—fully adapted—offer a channel for the most effective of straight teaching.

It appears from these conflicting opinions that the notion of a medium is not as simple as might at first appear; and that beyond the simple technical level, at which one can distinguish print, film, radio and television, some writers, like MacLean, and Biddle and Rossell above attempt to differentiate within these technical forms by referring to content, audience and format. It may even be that print has come to be seen as a single medium retrospectively, through comparison with the newer electronic media. McLuhan suggests that the right moment for the investigation of the mass medium of print in education was at the time of its invention:

Had any of our current testers of media and educational aids been available to the harassed sixteenth century administrator, they would have been asked to find out whether the new teaching machine, the printed book, could do the full educational job. Could a portable, private instrument like the new book take the place of the book one made by hand and memorized as one made it? Could a book which could be read quickly and even silently take the place of a book read slowly aloud? Could students trained by such printed books measure up to the skilled creators and disputants produced by manuscript means?
The significance here of the difficulties of defining a medium lies in the fact that factors other than technical ones may enter into the definition; thus in a discussion of mass media and educational media, it may be necessary to specify other elements in the communication situation, such as the content and the audience. Where these factors differ considerably, as they do between mass communication and formal education, the usefulness of referring simply to the medium as a common element must be questioned.

The print medium is important since it is a mass medium which is typically differentiated whereas the electronic media are not. In the second part of the thesis it is argued that a central factor which differentiates the textbook from programmed texts and broadcast media is the question of control over sequencing. Although the analysis is made in relation to the print medium, this is only because print provides the clearest example of optional source or receiver control over sequencing; the implications of the analysis extend to all media. This means that the 'strong communicator and little user control' which Biddle and Rossi suggest are intrinsic to the mass media may be only essential to certain forms of the mass media. For example, it is conceivable that a large-scale wire television service could be set up which would have the wide spread of use and low cost to the user that Biddle and Rossi mention, but which would allow considerable user control through a system of dialled programmes, selected by the user from an extensive catalogue.
The print medium calls in question not only the definition of medium, but of mass media.

Finally, it must be pointed out that the word 'mass' has complex associations, documented by Williams. This may be especially true for adult teachers and tutors.

Adult Education may be the means of converting what would otherwise be wasted time into creative leisure, capable through the release of undiscovered abilities of contributing to the enrichment of the common life. The worker-poet or novelist, the routine factory operative who finds his satisfaction in the practice of music, art or drama, the neighbourhood group which contributes to the beautifying of our sordid urban surroundings, are no longer to be regarded as isolated examples standing out against general apathy, but as portents of the new society if we have the will and the means to achieve it.

Peers is referring here to the less academic end of the adult education spectrum. As regards more formal instruction, the Report of the Planning Committee for the Open University states that 'the opportunity to engage in higher education is at last becoming widely accepted as a basic individual right'.

If adult education is conceived in majority terms, there can lie a challenge to it in the existence of the other majority provision of mass communication. Williams points this out:

Simply, my case is this: I do not think that a movement which only makes sense in terms of majority education can have any future except in the direction of majority values and a deep concern with the values of the whole society. We cannot go on overlooking the fact that alongside our kind of service, alongside the education service as a whole, is a communication service very mixed in quality, very questionable in control, which is going to play a decisive part in moulding the quality of our general life, and not merely the life of the masses.
It should become clear in the rest of this chapter that the literature of adult education shows considerable sensitivity on the question of the mass media. This may result from a tension arising out of the two potential roles of the new media vis-a-vis adult education: as challenging and competing elements in a mass culture, and as powerful allies in the form of new teaching aids.

1.4 The Dual Role of the Media

The rest of this chapter is divided into four sections. The first of these introduces various approaches to the study of communications, and in particular mass communications; the next two sections summarise literary opinion and social scientists' findings about the effects of media in mass communication; a third section deals with the use of the new media in formal education, and there is a short final section which returns to the problems of defining media, and mass media.

It should be explained why, in a study concerned with the use of media within formal education, it is necessary to consider the new media in their mass cultural role.

The mass media are unusual in that they exist both inside and outside formal education. This is not true of other teaching devices like the blackboard, the language laboratory or the overhead projector. But the mass media, and print must be included here, are associated as much if not more with entertainment and information as with formal education. In the case of radio, television and film, the educational use of these
media has been secondary in terms of both the proportion of time and money spent and the historical development to their use in mass entertainment and communication. It is possible that the adoption of these media within education has been influenced by the roles they play, or are thought to play, outside education, and that educators have been influenced by these factors as much as by research into the effectiveness of the media as teaching devices.

Some examples of the attitudes of adult educators towards the media of mass communication are given in section 3.3. These are considered against the background of brief summaries of literary and social scientists' views and findings about the effects of the mass media. Although useful overviews of social science research in the field are available25,26, and have been used, there is nothing comparable in the field of literary based study and the humanities. Rather than leave out this approach completely, which would present an unbalanced picture, it was decided to quote examples from a few writers who have been particularly concerned with mass media and mass culture. This has made the relevant section (3.1) unavoidably patchy, but until more research has been done into this subject, the evidence must remain scattered and difficult to summarise. The section is felt to be important, since adult educators seem to have derived their opinions about mass communication more from literary writers than from social scientists.

As a prelude to these sections, and more broadly to the whole thesis, the next section deals with various approaches to the study of communication in general, and mass communication
in particular, distinguishing four approaches; the literary, the social science, the semiotic and the mathematical. Only the first two of these are developed here, but since terms and models from the mathematical study of communications have permeated the whole field, it is necessary to refer to it. The summaries of literary and scientific work in the field are brief, and not intended to be anything more than a context for the analysis of the 'media-based approach' to educational development which is pursued in the next chapter.

Section Four of this chapter is devoted to an analysis of educational reasons for media adoption, as distinct from arguments based on analogies from mass communications. There is a brief summary and some conclusions in Section Five.
2. Approaches to the Study of Communications

The oldest approach to the study of communication is to be found in the study of aesthetics, which is concerned not only with the content and form of the work of art, but also its effects on the audience. This can be traced back to ancient Greece: Aristotle's theory of tragedy and Plato's strictures on poets and poetry both assert something about the effects of artistic communication. This concern with the effects of art has, in this century, broadened to become a concern with all mediated communication, whether it can be described as 'art' or not. Writers such as F.R. Leavis, Orwell and T.S. Eliot have been particularly interested in the relationship between the 'high' literary culture of the past and modern mass culture, mediated by film, print, radio and television. The contemporary work of Williams, Hoggart and Hall lies in this tradition. As quotations below will show, the comments of such writers are very often comments on the content of mass communication, with the effects assumed to be similar i.e. a bad novel has a bad effect. This emphasis on content analysis should not obscure the fact that these writers are dealing with a complete communication process, in which a sender and an audience are involved, and the implications of their criticisms, whether made explicit or not, extend to the effects of the communication.

Literary-based study of the mass media is being pursued at the Centre for Contemporary Cultural Studies at the University of Birmingham, and this has involved attempts to relate these
studies to the studies of social scientists in the field. This second approach can be dated from the nineteen-thirties. Schramm cites Lazarsfeld, Lewin, Lasswell and Hovland as the originators of communication research in the United States, where most of the early work was done. The orientation of the four was not identical; Lazarsfeld was a sociologist, interested mainly in political and voting studies. Lewin was a psychologist, concerned with group norms and group pressures. Hovland, also a psychologist, concentrated chiefly on identifying persuasive factors in the sender and the message. Lasswell devoted his attention to propaganda, and the techniques of content analysis. Thus, from the outset, the scientific study of mass communication has had a variety of aims and emphases, and Schramm has described the field as 'an academic crossroad where many have passed, but few have tarried'. Both literary and scientific study of the field has tended to concentrate on mediated, and therefore often mass communication. Roland Barthes, the semiologist, has also expressed interest in mass communications as a system of signs, and a potentially fruitful area of study.

This third approach will not be pursued here since it is unfamiliar to this writer. Nevertheless it appears to be distinguishable from either of the approaches described above.

A fourth approach to the study of communication derives from the mathematical study of communication developed by
Shannon and Weaver\(^3^9\). The work of Wiener\(^4^0\) on cybernetics has also been influential. These workers deal not with mass communication, but attempt to construct general models of communication which are applicable to all human and man-machine communication. Pierce\(^4^1\) and Cherry\(^4^2\) have given useful accounts of this approach. Parry\(^4^3\) discusses at some length the applicability of mathematical models to human communication. He distinguishes between the use of the term *information* to mean *uncertainty reduction* in the mathematical model, and to mean *content*, in general discourse. Although he believes there is an unbridgeable gap between the two, since it is extremely difficult to measure content, he argues that the mathematical model has had a significant influence on the general approach to human communication, since it has provided a basic model and useful terms with which to conceptualise problems:

*Scientific and mathematical models are invented to reproduce the salient features of limited ranges of phenomena. But it sometimes happens that a model exerts an influence far beyond its author’s intentions. It does this by generating concepts which shape and direct the thought of workers in other fields. Such an influence does more than fascinate and interest; it illuminates fresh areas, and in doing so advances understanding in a positive way. Unless this possibility is conceded, the irruption into psychology of terms like encoding and channel capacity must be dismissed for the same reason. We must naturally be on our guard against applying the Information Theory model in a confused and bizarre way; nor must we claim that information theory provides the answer to all the problems of human communication. It is obvious that it does nothing of the sort. All that is claimed is that it has offered a foothold on a slope where formerly there was no foothold at all.*
The influence of Shannon and Weaver's model on education can be seen in the light of the above passage. It contains the salient features of the communication process in education. But although it provides the foothold that Parry refers to, it also has limitations which will be examined below.

Given the different and possibly conflicting approaches to the study of communications outlined above, it is clear that there are considerable difficulties in formulating the right questions to ask about the communication process. General questions of the type asked about the mass media - Do the media brainwash the electorate? Do the media encourage violence? Can the media teach? - are usually too vague to be answerable.

The basic communication model of Shannon and Weaver\(^45\) is a useful starting-point in that it identifies certain basic components of the communication system (see Fig.1). There is an information source from which the message passes to a transmitter, which may encode it in the form of a signal. This signal is decoded by a receiver and from there the message goes to its destination. A source of noise, or interference, in the signalling may be present. Questions about the process can relate to any one of these elements. Lasswell formulates very similar questions in human terms:

<table>
<thead>
<tr>
<th>Who</th>
<th>Says What</th>
<th>In Which Channel</th>
<th>To Whom</th>
<th>With What Effect</th>
</tr>
</thead>
</table>

\(^46\)
Fig. I. Schematic Diagram of a General Communication System.
Following these divisions, communications studies can be broken down into various parts: control or source analysis (who ?) content analysis (what ?) media analysis (in which channel ?) audience analysis (to whom ?) and effects analysis (with what effect ?). There is an extensive literature covering most of these aspects of communication, but this study will concentrate mainly on the final question: the effects of communication. For it is the effects of the media on mass audiences, or the effectiveness of media in teaching that is the link between the use of the media inside and outside education. The problem of effects raises questions related to the other elements, since the researcher wants to know whether it is the source, the message, or the medium which is having the effects. However, it is the effects, rather than these other elements, which are at the centre of controversy, as the following quotation from the Yearbook of Education 1960 shows:

Those who use and control these media (and here we think more particularly of radio and television, although books and newspapers play their all-important part) must bear a special responsibility to the community at large, for the very reason that these media are so effective in creating an attitude of mind, in influencing the way men think. Countless millions have recently acquired a voice in the affairs of their country. If they are to exercise their rights in a democracy they must be able to judge the issues at stake in as unbiased a fashion as possible. The way the facts are presented is of prime importance. In the hands of the unscrupulous the mass media of communication can be a power for evil and democracy itself placed in jeopardy.
There are three points to note about this passage. The first is the assumption about the power of the mass media: '...for the very reason that these media are so effective in creating an attitude of mind, of influencing the way men think'.

This is an assumption about effects. The second point relates to the way in which these effects come about; there is no mention of any modifying influences, and it is assumed that the media have a direct effect on their audience. This direct cause-effect model, which is an implicit version of Shannon and Weaver's explicit model, underlies a great deal of writing on the mass media, and of communication in general.

The third point is that the attitude towards the mass media here is critical and defensive, possibly because the assumptions about effects are unqualified. This defensive tone is characteristic of much educational writing on the mass media, and will appear again in subsequent quotations.

The interest of educators in primarily in the effects of mass communication. Before considering the findings of literary-based study and social science on this subject, it is necessary to note several limitations to the Shannon and Weaver/Lasswell model described above. This is essentially a direct cause-and-effect model, and pervades both scientific and literary-based study of the field. It is the adoption of this model, which tends to minimise social and other factors in the communication process, more than the conclusions which are drawn from studies based on it, which is intrinsic to the 'media-based approach' to the use of media in education.
The first drawback to both Shannon and Weaver's and Laswell's formulation of the process of communication is that they do not allow for feedback. The implication is that communication is a one-way process, with nothing to close the loop back to the communicator. This is more true of mass communication than interpersonal communication, but it can be misleading when media typically used for mass communication, like radio and television, are used in educational settings where more feedback becomes possible. This feedback may come with the use of another medium, such as the telephone or correspondence education, but the omission of feedback in the model is just as important as the inclusion of the other elements, for it suggests that the basic communication process is one-way. It is arguable that the basic communication process in education is two-way.

A second point about both models is that they imply that the process is always initiated by the same sender. There is no suggestion that the receiver may in turn become the sender, and the original sender the receiver. In fact, the distinction between sender and receiver is a fine one, based on who initiates the process, and who transmits most of the time. In an evenly balanced conversation between two people, it would be difficult to identify any sender or receiver, since both parties are sending and receiving. There will thus be two feedback loops; one to each sender. In educational terms, this means that there can be both feedback to the teacher.
about his teaching, and feedback to the learner about his learning. These are not necessarily the same. A student who asks an unsolicited question, and gets an answer to it from the teacher may get feedback about his learning, while the teacher may be quite at a loss to know why he asked that question. Similarly, tests and examinations set by the teacher may give the teacher information about the success of his teaching, but may provide little feedback to the learners, especially if their examination papers are not returned to them. Models of the single and double feedback loop situations are given (See Fig. 2, 3).

A third limitation to Lasswell's formulation is that it omits any mention of chains of communication. The model suggests a single source and a single receiver. This again is inappropriate in the class situation where there may be a single source and a number of receivers, each of which can interact with the other. In a broader social context, Katz has argued that the mass media tend to affect their audience through the mediation of 'opinion leaders', who pass on selected information, with the stamp of their approval, to their associates. This theory of 'two-step flow' has been extended to the general conclusion that 'interpersonal communication networks mediate between the mass media and their individual targets'. A textbook used in a class can be mediated in this way by a teacher, who selects from it and interprets parts of it for his students. Similarly a broadcast television lesson may be interpreted by the live teacher at
One-way Communication System with Feedback.

Fig. 2. One-way Communication System with Feedback.

Two-way Communication System with Feedback.

Fig. 3. Two-way Communication System with Feedback.
the end of the broadcast. There are apt to be a number of sources of information in the adult class; the tutor, the mediated sources such as television programmes and books, and not least the other students. This raises the final and related criticism of Lasswell's\textsuperscript{55} model, which is that it tends to abstract the effects of mediated communication from all other communication. In social terms, this means abstracting the effects of the media from the effects of communication in the family, among peers and the whole complex of interpersonal relationships. In educational terms, it plays down the fact that mediated instruction often enters an existing interpersonal communication process, in which teachers and students are involved. Even when the student is most isolated with mediated teaching, working alone in a carrel with a videotaped lesson, the relationships before and after the lesson with the teacher and other students, and more generally with his friends and family, affect the way he receives and interprets the information being transmitted. Katz describes this 'direct' model in the following terms:

The model in the minds of early researchers seems to have consisted of:(1) the all-powerful media, able to impress ideas on defenceless minds; and (2) the atomized mass audience, connected to the mass media but not to each other.

Empirical research rapidly dispelled this simple set of images and proved how difficult it is to "convert" people by means of mass media alone.
Halloran makes a similar point in a recent publication:

A model held by many people when they discuss communication, particularly mass communication, is an 'exploitative' model, a model of one-way influence; of the media doing something to people. This model is even implicit in certain research designs. It should be clear now, however, that the initiative is not entirely with the communicator. An 'exchange' model which takes into account group influences and interpersonal relationships is likely to be much more helpful in understanding the communication process than a one-way model.

He suggests that interpersonal factors must be taken into account in the use of media for adult education:

Members of adult classes, or viewers of educational programmes do not come to the learning situation as tabulae rasaee, nor do they go away from it into splendid isolation, there to cogitate and meditate in silence. These people have friends, belong to families, have relationships, have had experiences; they hope, dream, fear, aspire, love and hate. As we shall see, our understanding of the communication process will be severely limited unless we take these and other relevant factors into account.

The general point made by both Katz and Halloran above is that mediated communication cannot easily be taken out of its social context, and that the effects of mass communication or educational communication are likely to be influenced and modified by other factors not intrinsic to the media themselves. This means that it is important to place the media in the context of their use, and that arguments based on findings in one context may not necessarily hold in a different context.

Four criticisms have now been made of the simple communication model used by Shannon and Weaver and Lasswell.
It does not include feedback loops; it suggests that there is always the same sender, and always a single receiver; and that there are no external factors which modify the effects of the communication. Nevertheless, this has been an influential model, both in mass communication research, as Katz has noted, and in education according to Ely. It is a model implicit in some early literary writers and critics, in particular Orwell and Huxley. Finally, it is a model adopted implicitly by many educational writers, as evidenced in the quotation from the Yearbook of Education. Its influence on adult educators will be documented in section 3.3. Having noted the importance of this model, and also the criticisms made of it, it is now time to examine some of the answers provided by both literary-based writers and social scientists to questions about the effects of mass communication.

3.1 The Content and Effects of Mass Communications:

the Literary View

As noted above, there appears to be no available summary of literary-based study of the mass media. In the absence of this, it has been decided to review briefly the opinions of a number of literary writers and critics, who have shown a particular interest in the mass media and mass culture. This can provide no more than an impression of the main trends of opinion, and much more research in this area needs to be done. However, since adult educators appear to have assumptions about the media similar to a number of literary writers, and do not seem to have paid much attention to scientific research
in the field, it was felt that some overview of the literary opinions, however inadequate, should be attempted. As noted earlier, literary criticisms of the mass media typically take the form of criticisms of content, with implicit assumptions about effects.

A number of novels have assigned great and sometimes horrific powers to the mass media, and may have helped to establish the 'simple set of images' which Katz referred to. In particular, Aldous Huxley's Brave New World and George Orwell's Nineteen Eighty-Four were widely-read works, and form part of a somewhat apocalyptic view of the mass media which also reappears in parts of McLuhan's and Marcuse's work. It would be an interesting research task to try and assess how much influence these writers have had, not only on lay opinion, but on the formulation of research hypotheses in the field. Unfortunately the question must be left here, since it is not the main concern.

Apart from this general view of the media, which gives them almost unlimited powers of persuasion and indoctrination, there are criticisms of various aspects of the mass media and mass culture. One of these, which has to do with the sheer quantity and variety of stimuli that the media provide, was voiced in 1930 by Leavis:

A reader who grew up with Wordsworth moved among a limited set of signals (so to speak); the variety was not overwhelming. So he was able to acquire discrimination as he went along. But the modern is exposed to a concourse of signals so bewildering in their variety and numbers that unless he is especially gifted or especially favoured, he can hardly begin to discriminate. Here we have the plight of culture in general.
This is an argument relating not so much to the media themselves as to the cultural pluralism of which they are a part. Leavis is arguing that the detrimental effects are a result not of poor content, or of the absolute power of the media to persuade, but of the sheer variety and quantity of provision. This criticism might apply equally to high art or mass art; the essential point is that the time and leisure needed to respond properly to each artifact is lacking. Although the mass media are the main carriers of this overwhelming variety of stimuli, they are not in themselves the cause of the trouble. This is not a criticism which assumes the direct cause-and-effect model, and does not make any assumptions about the effects of individual programmes or types of content. And although it may lead to a defensive attitude towards the mass media, it is not an attitude which assumes anything about the use of mass media for teaching.

Hoggart, who in his own work, and in his capacity as Director of the Centre for Contemporary Cultural Studies at the University of Birmingham, has been consistently concerned with the study of the mass media, criticizes them from a different point of view: he objects not to the variety of stimuli, but to the type of stimuli:

Most mass-entertainments are in the end what D.H.Lawrence described as 'anti-life'. They are full of a corrupt brightness, of improper appeals and moral evasions. To recall instances: they tend towards a view of the world in which progress is conceived as a seeking of material possessions, equality a moral levelling, and freedom as the ground for endless irresponsible pleasure. These productions belong to a vicarious spectator's world; they offer nothing which can really grip the brain or heart.
This is a description of content, not of effects, but Hoggart goes on to say that the mass media are a contributory factor in 'a gradual drying-up of the more positive, the fuller, the more cooperative kinds of enjoyment, in which one gains much by giving much'\textsuperscript{74}. He describes a similar effect in another passage:

\begin{quote}
This regular, increasing, and almost entirely unvaried diet of sensation without commitment is surely likely to help render its consumers less capable of responding openly and responsibly to life, is likely to induce an underlying sense of purposelessness in existence outside the limited range of a few immediate appetites.\textsuperscript{75}
\end{quote}

Hoggart stresses both the moral doubtfulness of the stimuli presented and the fact that they provide vicarious rather than direct, interpersonal experience. He assumes that both of these features of the mass media will have a bad effect.

Another approach to the mass media is provided by Williams\textsuperscript{76}. He concentrates on the organisation and control of the mass media, arguing that these aspects of mass communication are fundamental in any discussion of content or effects. He distinguishes between four kinds of control over the mass media:

In one way, the basic choice is between control and freedom, but in actual terms it is more often a choice between a measure of control and a measure of freedom, and the substantial argument is about how these can be combined. Further, the bare words 'controlled' and 'free' do not seem sufficiently precise, in themselves, to describe the kinds of communication system which we have had or known about or wanted. I believe we can distinguish four main kinds, and that to describe and compare these will make our thinking about control and freedom more realistic. The four kinds are: authoritarian, paternal, commercial and democratic.\textsuperscript{77}
Williams goes on to discuss these four types of system in detail, and makes proposals which he believes would lead to more democratic control of the mass media. He suggests the amending of certain institutions of mass communication, and advocates more teaching of writing and criticism in schools.

Denys Thompson, on the other hand, is more concerned with the content and the effects of the mass media in his introduction to *Discrimination and Popular Culture*:

Our national culture is being replaced by a synthetic substance that exists only in the media. For instance, no one outside an agency ever talks like an advertisement, and the attitudes of the popular press are rarely a crystallization of what any of their readers feel, just as the language in which the news is conveyed is a special one never spoken in real life. The 'midatlantic' speech of entertainers and others exists at present only on radio and television, though doubtless it will soon spread thence. Television in particular is seen by some observers to be the agent of moral and aesthetic education, supplying a continuous stream of attitude-forming information under the label of entertainment, replacing the teaching of church and family and school.

A less pessimistic view of the mass media is taken by Hall and Whannel. Commenting on what they see as a whole tradition of cultural criticism represented by writers like Leavis and Thompson, they argue that their view of the media is conservative and nostalgic, because it contrasts the supposedly organic culture of the past with the mass-produced culture of the present. This, they say, leads to a primarily defensive and limiting view of present developments, with possibly restrictive results for teachers. They argue that the modern cinema with directors like De Sica, Bergman and Antonioni need not be approached in such a defensive manner, and argue that the problem lies in distinguishing good from bad.
within the media.

In terms of actual quality (and it is with this, rather than with 'effects' that we are principally concerned) the struggle between what is good and worthwhile and what is shoddy and debased is not a struggle against the modern forms of communication, but a conflict within these media. Our concern is with the difficulty which most of us experience in distinguishing the one from the other, particularly when we are dealing with new media, new means of expression, in a new, and often confusing, social and cultural situation.

Although they criticise the conclusions of the Leavis-Thompson school, they follow their analytic method, with its emphasis on close attention to text and style.

Hall and Whannel make some criticisms of the vagueness of much literary writing on the mass media which are echoed by Halloran, who views them as a social scientist. He argues that difficulty of showing any consensus among the various views and opinions may result partly from vague terminology and partly because most of the 'evidence' is highly subjective.

When one makes a survey of this field one is immediately struck by the degree of conflict, disagreement and confusion which appears to exist. Some of this must stem from the fact that there is not a common use of terms. For example, in describing culture 'high', 'low', 'modern', 'mass', 'superior', 'minority', 'popular', 'genuine', 'serious', 'vulgar', 'brutal', 'refined', 'elaborate', are freely used, yet adequate distinctions are rarely made. Moreover, much of the evidence used is highly questionable, unsubstantiated and at times anecdotal; yet unqualified generalizations abound.

Hoggart, in the Uses of Literacy, states that he feels there is sufficient consensus in assumptions to allow him to use a number of evaluative terms without rigorous definition.
Halloran may underestimate the degree to which literary critics understand each other's discourse. But he does point to the difficulty of arriving at any conclusions about the literary view of the mass media, if there is such a thing. A number of writers have been quoted here who have made this subject their particular concern. Most of them appear to have adopted a defensive attitude towards the mass media, but their reasons for doing so, and the kinds of effects they believe that the mass media have on the population, vary a good deal. Moreover, much of the criticism is extremely general. It would be quite unjustifiable, on the basis of the relatively few works examined to impute generalized attitudes to the literary critics of the media. There is the impression, and it cannot be put any stronger than that, that they are by and large suspicious of and on the defensive against the mass media. This attitude becomes much firmer when we examine educational opinion on the subject, and it is possible that teachers have taken their cue from literary critics like Leavis and Hoggart, rather than from other sources. But the one point, and it is a central one in this discussion, which does emerge is that these writers are using the model which Katz criticized, which views the media as having a powerful and direct effect on the individual. Leavis mentions nothing which might filter or modify the 'concourse of signals'; the 'improper appeals and moral evasions' which Hoggart refers to are apparently perceived by the spectator without any intervening influences; Thompson writes of television as an 'agent', without any qualification.
This view of the media as isolable agents, acting powerfully and directly upon an atomised society in which all intervening influences appear to be either in abeyance or too weak to take into account seems to be pervasive in the literary study of the media. It is possible that this view has influenced the thinking of teachers on the subject of both mass communication and of the use of mass media in education.

3.2 The Effects of Mass Communications \& Scientific Study

The scientific study of the media, in contrast to the literary based study, has been well documented, and an extensive literature exists. A useful overview of this has been provided by Halloran\(^92\), who has also related it to adult education\(^93\). Several volumes of readings on the subject have been edited by Schramm\(^94,95,96\). The brief summary given here will concentrate on that part of communications research which has dealt with effects.

Halloran\(^97\) has noted that research has provided very few definite answers to the kinds of generalised questions that people ask. Social scientists, he writes, may even have added to the confusion by 'providing evidence in partial support of every view'\(^98\). The most dispiriting conclusion was arrived at by Berelson: 'Some kinds of communication on some kinds of issues, brought to the attention of some kinds of people under some kinds of conditions, have some kinds of effects.'\(^99\).

Klapper, however, was able to list some emerging generalizations in 1960. These include:
I. Mass communication ordinarily does not serve as a necessary and sufficient cause of audience effects, but rather functions among and through a nexus of mediating factors and influences.

2. These mediating factors are such that they typically render mass communication a contributory agent, but not the sole cause, in a process of reinforcing the existing conditions.

The Television Research Committee, in their Second Progress Report (1969) note that generalizations like these, which seem to play down the possible effects of the mass media, have received more than their fair share of attention. They point out that little work has been done on the effects of mass media on early child development, and that media studies have not to date taken into account the genre, context or mode of presentation of the content. They emphasize that on occasions the mediating factors may be absent, or that they may be working to reinforce the effect of the medium. Klapper's emphasis on mediating factors can be seen as a reaction against the earlier simple cause and effect model criticized by Katz. If the general effect of Klapper's work has been to allay some of the fears expressed by the literary writers, it now seems that research is moving back again towards the view that under certain conditions, the media can have a detrimental effect.

The Television Research Committee cites the case of the effect of media violence on frustrated or maladjusted people. They also point out that whereas most of the research on attitude change has been done in high-involvement areas — where a change of attitude would be important and central to the subject — it is possible that in areas where people do not feel themselves
so deeply involved, the media may be having a slow but cumulative effect. Pool has pointed out that if the power of the media to affect opinions overtly is small, their power to inform and by selecting the information presented, to bias opinion, is enormous. The Television Research Committee states in conclusion that

...maximal impact seems likely to occur where there is repetition of the message, where emotional reactions are brought into play, where the values presented link with the individual's immediate needs and interests, where there is an uncritical attachment to the medium and where other values have not been supplied through the immediate environment and through social relationships. Many of these conditions appear to be present in advertising, and the Committee's conclusions seem to confirm in theory what public relations men have known in practice for some time. But in the more general field of the relationships between the media and cultural values, the Committee can give no clear-cut answers.

The conclusions that can be drawn from these summaries of media research by social scientists are almost as inconclusive as those coming from literary analysis, though for different reasons. If there is over-generalisation in the literary approach, there appears to be a lack of theory in this one. If the scope of some literary assertions is so vague as to be useless (e.g. 'anti-life'), the scope of what scientific findings there are, is so narrow and trammelled by conditions, that generalisation from them is hazardous. The middle ground of enquiry, where one might expect reasonably precise answers to reasonably precise questions, is touched by neither as yet.
The Committee recognises this shortcoming:

Mass communication research in general can be criticized for not giving adequate attention to wider value considerations both with regard to the mode of operation of the mass media themselves and to the policies and objectives of mass communication research. So-called objectivity and neutrality allied to excessive caution (holding back until a definitive statement is available) has frequently led to research being used to oppose change, defend the status quo and occasionally to absolve the policy and decision makers in the media from their responsibilities with regard to the effects of their products.

Hall and Whannel make their criticism of the analytic literary approach:

The debate about mass communications is all too frequently conducted at the level of generalities, and much of the writing on the subject has little sense of a personal response. It is not even clear what is meant by terms like 'mass media' or 'mass communications'. Experiences, attitudes and values are communicated in a variety of ways. Which of these do we include when we speak of mass communications? Do we, for example, include — along with the cinema, TV, press, etc. — the large chain stores like Marks and Spencers which have so obviously influenced taste?

If social scientists have been over-concerned with objectivity, Hall and Whannel argue that some literary analysts have lacked the essential personal response to the product, and have failed to define their terms clearly. The net result has been that no firm guidance has been given to public debate on the subject, and the problem of effects remains largely in the realm of speculation.

If this brief survey of communications research and analysis offers little guidance on the problems of effects, it does throw light on the basic model being used.
It was noted above that the simple cause-effect model was common in literary writing. The Television Research Committee notes its continuing influence in scientific studies also:

It is worth noting that many of the studies in mass communication research (despite the availability of corrective evidence) apparently continue to work on a basic assumption of the atomistic nature of the communication audience. In recent years the movement away from this atomistic conception, from the view of the audience member as an isolated individual with inadequate primary relationships, appears to have been considerable, but there are still those who would argue that we have not gone far enough.

This implies that communications research should cease to be 'media-based', but should view the medium as simply one among a number of influential factors in a situation. The more general implications of this shift of approach are taken up in the final part of this chapter. The next section will examine the attitudes of adult educators to the mass media and mass culture, in the light of this brief survey of research.

3.3 Adult Education and Mass Communications: some attitudes

For teachers and tutors, the question is not only the possible effects of mass communications on society, but the relationship between their kind of formal educational provision, and the entertaining, informative and sometimes educative provision of the mass media. It is worth quoting Williams again on this:

We cannot go on overlooking the fact that alongside our kind of service, alongside the education service as a whole, is a communication service very mixed in quality, very questionable in control, which is going to play a decisive part in moulding the quality of our general life, and not merely the life of the masses.
In the preface to the second edition of *Communications* (1966) he argues that the present system of mass communications constitutes a teaching force which he sees at odds with older and more democratic traditions of permanent education, represented by adult education in its various forms.

The choice is then clear. The need for permanent education, in our kind of changing society, will be met in one way or another. It is now on the whole being met, though with many valuable exceptions and efforts against the tide, by an integration of this teaching with the priorities and interests of a capitalist society, and of a capitalist society, moreover, which necessarily retains as its central principle (though against powerful pressures, of a democratic kind, from the rest of our social experience) the idea of a few governing, communicating with and teaching the many.

This broad view of education and mass communications in competition with each other, is voiced by other writers who do not share Williams' particular political orientation. Shaw, writing in Raybold's *Trends in English Adult Education*, speaks of adult education as a kind of resistance movement fighting the effects of the mass media:

Since it is part of a mass democracy, the greatest temptation of adult education is to compromise too far with its environment. It might seek to go 'forward with the people' by taking a leaf out of the Daily Mirror, or a lesson from commercial television at its powerful worst. My own conviction is that university extra-mural education must be part of a resistance movement to the trend towards an Admass society, with tutors and administrators who are democrats always on their guard against becoming demagogues.
In the Harvey Memorial Lecture given in 1958 on Adult Education and Mass Culture, Briggs distinguishes between the effort necessary in adult education and the apparent passivity associated with the mass media:

Now the kind of continuous adult education which seems to me to be most worthwhile always involves effort, not as some people think because there is a lingering Puritanism in the adult education movement which tinges pleasure with pain, but because an element of effort is necessary before an idea can be mastered or a work of art understood. The need for effort is bound up with the transition from the passive to the active, a transition which all good adult education classes should stimulate. The undeviating TV watcher in his armchair, the persistent picture-goer in his cinema-seat, the silent newspaper reader in the railway carriage, are in danger of letting issues come and go, ideas flit backwards and forwards, in at one ear and out at the other, without really caring about any of them.

Other writers on adult education have taken up a similar defensive position, though for varying reasons. Jessup, for example, writes of 'the frightening power, in our society, of the forces of Admass.' Hoggart seems to view the W.E.A. as part of the resistance movement. The debate about adult education and mass communications can be followed in various articles in the journal Adult Education. Groombridge asks for more careful understanding of the problems:

It seems clear that popular arts using the mass media are likely to remain a principal feature of this new culture, and adult educationists need urgently to decide where they stand in relation to them. Most theorising among people of advanced education about these arts is a sad mess of snobbery, misapplied sensibility and sheer misunderstanding. People delight in being told how wicked the world is, and it is too easy to set heads nodding with moral fervour against commercialised entertainment of them, the masses. Educationists are very prone to this.
Without a systematic survey of attitudes towards the mass media and mass culture held by adult educationists, there can be no firm conclusions on the subject. Two things do however appear in the above literature. The first is a suspicious, if not actually defensive, attitude towards the media. Williams describes them as 'mixed in quality, very questionable in control'; Shaw refers to the dangers of 'commercial television at its powerful worst'. Briggs pictures the entirely passive audience of the media, although his general attitude to the media is careful and discriminating; in certain cases, he says 'adult education may be able to build on interests awakened by the mass media'. Jessup sees the media as frightening, and Hoggart's views have already been quoted. Groombridge, quoted above, is the main exception to this trend. This overall defensiveness can have implications for the adoption and use of media in education, which will be examined below.

The second feature that emerges from most of this writing is that the power or influence of the mass media is not questioned. Having seen the relative absence of firm findings on the question of effects, which might lead to scepticism about their power, it is a little surprising to find that most adult educationists take it for granted that the mass media do have great power. Shaw refers to the 'powerful worst' of commercial television; Briggs describes the TV watcher as 'undeviating'; Jessup talks of their 'frightening power'.
The assumptions about the effects of the mass media which appeared in the *Yearbook of Education* reappear here, with very little qualification. Adult educationists do not seem to be acquainted with social science work in the field.

These two assumptions — that the mass media are potentially competitive to education, and that the mass media have powerful effects — have implications for the use of media in adult education. Apart from concrete and technical reasons for using the mass media in education, which will be examined in the following sections, it seems possible that reasons for adoption have been influenced by assumptions about the effects of media outside education. It is for this reason that it has been necessary to look, however briefly, at the relationships between adult education and mass communications. The assumptions that the mass media are both competitive and powerful outside education, can lead to the following assumptions about the media as teaching aids:

1) Because the teacher is essentially in competition with the mass media, he should be given as many of the same technical advantages as possible.

2) Because the mass media have powerful effects outside education, they will have powerful effects within; i.e. they will be powerful teaching instruments.

Both these conclusions are made explicit in the introduction to the *Yearbook of Education* (1960). The editors write:

The active use by teachers of media which, for good or ill, have become powerfully educative is part of the answer to the challenge they face. Unless educators take the threat to their value systems seriously and learn to use modern methods effectively, their influence will decline as surely as has that of the priesthood.
Formerly, their function rested upon the ability to teach people the difficult art of reading—in the full sense of that term and not just the translation of visual symbols into sounds empty of meaning. Other agencies now compete to unlock the doors to knowledge. With their books and blackboards, teachers now face politicians, industrial tycoons, and business men backed by their films, radio, television and illustrated magazines. They must counter with similar means.

This quotation may not be representative of attitudes in adult education on these matters, for, as Jensen has pointed out, schools are to some extent inmate-keeper institutions, whereas adult education is a less 'protective' activity. Adult educators may not view the appearance of new educative agencies in society with such alarm. However, an argument very similar to the one used in the Yearbook of Education above is used in the preface to a recent book on Adult Education and Television:

Educators were at the outset inclined to be sceptical, thinking more of the dangers inherent in this form of mass communication. Mindful already of the diminishing amount of time spent on studies, they foresaw a dispersal of interests and the consequent fragmentation of impressions, aggravated by the inanity, the violence and the perversion which characterize many television programmes. But these reservations were unavoidably cast aside: television played too large a role in man's daily life. Clearly television had to be taken into partnership and its power harnessed for the purposes of information and leisure-time amusement, and if possible, for the education of adults and children.

This is based on the more fundamental assumption that the mass media are powerful. The editors of the Yearbook also seem in doubt about this; the media are 'powerfully educative'. There is no mention in either of the above
passages of mediating or qualifying factors, either inside or outside the classroom, and no distinction made between the media acting in a formal instructional context and in a less structured 'educative' one. This leads to a dilemma; the media can be seen as powerful teaching aids, but not so powerful as to supplant the teacher altogether.

In countries that are technically and economically more advanced the use of film, radio or television is regarded as an extension or supplement to the work of the teacher. These and other media can quicken the interest and widen the experience of the pupil in a manner that no teacher could achieve without their aid. It is not intended, however, that they should supersede him in the classroom.

This view would confine the uses of mass media in education to the enrichment of teaching. This is valuable but marginal, since if the teacher has not been able to do this himself, without these new aids, it follows that it is not an essential part of teaching; if it had been, the whole teaching provision would have been incomplete until the arrival of the media. Pasquali sees this as an attempt to rationalise, in the Freudian sense, the uneasy relations between mass education and mass communications.

Education — this supreme form of communication and so of interpersonal relations — had before this an initial reaction which still characterizes its more conservative elements today: simply to ignore the presence of such media, and consider them as marginal elements with a function of mere entertainment and spectacle, unable to affect the sacred and inaccessible jurisdiction of education. Later, harassed by those who systematically contradicted such an inconsistent theoretical position, another section of the profession gave citizen's rights to the mass media of communication, but this time again, the attitude was undermined by timidity and myopia.
In their attempt to assimilate and neutralise the new within the old instructional forms, they invented the unhappy formula of "resource" or "audio-visual aid" with which they pretended to rationalise the problem of the relationships between school and cinema, radio and television.

Pasquali goes on to say that the second attitude is in fact more conservative than the first, and an abdication of responsibility for all cultural transmission which does not take place within the framework of formal education. Even if the relationship between the uses of media within and outside formal education is not considered a problem on a general level, it can present practical difficulties. Groombridge writes that 'viewers' experience of and response to educational programmes is likely to be conditioned by the rest of the programmes. He considers that educational and non-educational programmes form a continuum. Similar views have been expressed by Trenaman and Cassirer. Maclean writes 'there is a real danger of a student's expecting anything shown on television monitors to be an option to conventional teaching.'

The relationship between education and the mass media may thus have influenced the use of media within education in several ways. The view of the media as hostile and competitive to the traditions and provision of adult education, may have stimulated educators to 'counter with similar means' by using the media for their own purposes. The assumption that the mass media are powerful i.e. that they have strong
and direct effects on the audience, may have led to two beliefs; that the media would be just as powerful within education, thus providing the educator with a powerful new ally, but also a potentially overpowering one. From this it would follow that the right course of action would be to use the new media, but to use them as 'aids' rather than agents in their own right. School teachers seem to have been more articulate about these hopes and fears than adult educators, possibly because they feel more threatened, and possibly because there are more of them, and the literature is more extensive. To this extent then what can be argued with a good deal of weight in relation to school education remains much more conjectural with adult education. It is clear at least, from the examples quoted earlier that some adult educators believe the mass media to be both powerful and competitive. There is some evidence that this reasoning has led them to try to 'harness the power of the media' for educational purposes. In the next section, some of the more concrete reasons for utilizing media in education will be enumerated, as well as some of the doubts about the power of the media to teach.
4.1 Mass Media in Adult Education

Recent literature on the subject of mass media in adult education has been reviewed by Ohliger*. Other major sources include the report of the UNESCO Meeting of Experts on Mass Media in Adult Education and Literacy*, the report of the Prague Seminar on Mass Media in Adult Education*, and a series of four books on the new media by Schramm and others*. In addition, works by Groombridge*, Cripwell*, MacLean* and Trenaman* are useful. The literature on the use of mass media in education in general is very extensive, and some major sources are listed in the bibliography.

4.2 Mass Media in Adult Education: Effectiveness

The reasons quoted in the last section for the adoption of media in formal education may have obscured the fact that some adult educators are not convinced that the new media are effective in teaching, or that at best they occupy a very marginal role. This belief may also stem from the analogy of mass communication. If it is assumed that the mass media are powerful i.e. that they have strong and direct effects on their audience, two conclusions can follow from this. The first, already suggested, is that the media must be equally powerful, or effective, as teaching aids. A second, and opposite conclusion, is that since the media are effective at informing or entertaining people, they will not be suited to educating people, since this is basically a different kind of activity.
This belief can be coupled, as it is in the following quotation with the belief that 'real' teaching and education is an interpersonal, not a mediated process. Kingsbury, reporting on a recent conference on the Open University, records this second argument:

Once again the traditional academic note of warning and mistrust is sounded — all those larks with radio and television may be good for stimulus and educational embellishment, the Report seems to be saying, but it is in the face-to-face tutor and student situation that the real university education takes place. A sine qua non, many would hold; certainly this was the collective opinion of the adult tutors in university extra-mural departments who gathered at a recent conference on the Open University at Shap (Cumberland). With most, the opinion is held for the wrong reason; it stems from a disbelief in the educational power of television acting alone, although perhaps not taking the extreme Muggeridge point of view that the medium is vulgar and trivial.  

Thompson expresses a similar view elsewhere. Kingsbury also notes that professional broadcasters reinforce this polarisation of education and entertainment, presumably for commercial reasons; they consider that low-rating educational broadcasts take up air time which could be used more profitably. At the other extreme, the original White Paper on the 'University of the Air' oversimplifies the situation:

In the educational world, as elsewhere, technological discoveries are making a profound impact. Television and radio, programmed learning and a wide range of audio-visual aids have already brought about considerable changes. The most important, undoubtedly, is that the best of our teachers can now be made available to vastly wider audiences. A distinguished lecture that at one time might have been heard only by a handful of students, or a few hundreds at most, can now be broadcast to millions of listeners. It has, therefore, become possible for the first time to think in terms of a University of the Air.
The reduction of university education to the opportunity to hear a number of distinguished lecturers ignores the interpersonal element in teaching completely. This original and rather hasty conception of the role of broadcasting in the Open University has since been considerably modified.\(^{159}\)

The views expressed in the above two quotations, although conflicting, have one thing in common: they both stem from an argument by analogy. It is being asserted that because the mass media fulfill certain roles outside education, they can, or cannot be useful in teaching. In the first passage, the assumption is that the media cannot move beyond their rather marginal roles as 'educational embellishment'; in the second passage, teaching has been reduced to those things, like lecturing, which the mass media can transmit well. Both these arguments are characteristic of a 'media-based' approach to educational development, which tends to minimise the factors other than the medium which are operating in either the social or instructional setting.

Schramm\(^{160}\) gives references to extensive research which has taken other educational factors into account, and thus provides a much firmer basis for arguing the usefulness of the mass media in education. He summarises the findings of this research as follows:

*Given a reasonably favourable situation, a pupil will learn from any medium — television, radio, programmed instruction, films, film strips, tape recordings, or others. This has been demonstrated by hundreds of experiments. A pupil neither turns off nor turns on his learning when he moves his attention from a teacher to one of the media, or vice versa. In general, the same things that control the amount of learning from a teacher face to face, also control the amount of*
learning from educational media — among others, the relevance and clarity of the content, individual abilities, motivation to learn, attention, interest in the subject, respect and affection for the teacher, emphasis and replication of the central points to be learned, and rehearsal by the learner.  

This emphasis on factors other than the medium is supported by Trenaman's findings, which are discussed later. As for 'comparisons' of the media with other forms of teaching, usually face-to-face, Schramm reports that significant differences rarely appear. This kind of experiment is difficult to design well; it is difficult to isolate the medium as the only differentiating factor, and control other factors such as variations in content, personalities of teachers or novelty effects in the mediated presentation. In certain cases, he adds, the balance swings one way or the other:

When the comparison emphasizes things a teacher in the class-room can do especially well — take care of individual needs, answer questions that cannot easily be anticipated before the class period and included in the presentation, conduct discussion, supervise practice, and the like — then more learning is likely to take place in the class-room. When the comparison emphasizes things the media can do especially well — present a truly excellent teacher, present a lesson that has to be prepared with more care and free time than a class-room teacher can usually afford to give it, give demonstrations that would be beyond the ability or the resources of a class-room teacher, cope with the need to focus group attention on a very small or a very large target — then the advantage falls on the media side.

The importance of these findings is not that mediated teaching can be substituted for live teaching, but that educators need no longer think in terms of choosing between media and direct teaching on grounds of the medium alone.
As Schramm points out, 'we are always dealing with combinations of media and direct teaching, systems of teaching devices and learning experiences'. Wiltshire and Bayliss, discussing open-circuit television teaching in adult education make a similar point: 'We ought not to waste time setting up more experiments to show that it works; it does.' It follows that the emphasis now should be on examining the settings in which mediated teaching can be used to advantage, and in the next section some basic reasons for using the mass media in adult education are suggested.

4.3 Mass Media in Adult Education: reasons for use

Various concrete reasons have been advanced for using the mass media in adult education; some of these relate more to developing countries than developed countries and vice versa. Four main reasons will be identified here; the mass media can be used to multiply resources; to distribute them; as means of updating and supplementing existing provision; and as means of reaching clientele who, for one reason or another, do not make use of the existing provision.

Basic to all four is the view of mass media as a resource which can be used in education. This is stated clearly in a recent UNESCO report:

Broadcasting should be considered part of the country's basic facilities, like harbours, roads, electricity, for the provision of which funds are invested not merely for immediate and identifiable results, but which are rightly believed to promote a long-term increase in national production. As with investment in education, broadcasting resources should be expected to yield results in the form of an informed, motivated and skilled people, leading to the increased availability of productive manpower, whether in urban or rural areas.
The difficulties of measuring the yield of broadcasting are very great, but the general point still holds, and Schramm has described numerous ways in which the mass media can be used to aid national development in developing countries. More specifically, another UNESCO report sees the mass media as one of the resources of adult education:

In most development plans, the fields of education and communication are treated separately. Instead of this, the systems approach envisages that there ought to be an institutional framework within each country to enable various resources of adult education, including mass media, to be integrated components operating in a single system.

There may be institutional difficulties, among others, in implementing such resolutions. If broadcasting has acquired the role of being mainly an entertainment and information agency, it is a little naive to expect that it will suddenly begin to see itself as a basic educational resource, to be used nationally as the need arises. More specifically, however, the uses of the mass media can be outlined as follows:

4.31 **Multiplication of resources**

The mass media allow resources to be multiplied to the extent that receivers are available. Thus, as the White Paper on the University of the Air noted, distinguished lecturers can broadcast to millions of people whereas before they were heard by only a small group. Even Radio Three educational broadcasts, which have very low audience ratings by the standards of the rest of the programme output, command audiences of many thousands. 'Mass' is a relative term, and minority
broadcasting may still count as mass education.

This power of the media to multiply holds promise for those educators, especially in developing countries, who are faced with mass problems and slender resources. The existing provision is often not organised on the necessary scale to meet the demands created by a newly literate or mobile population. Thus the mass media seem to offer a mass solution to a massive problem. The crudity of this view arises from a failure to relate the media to the total instructional framework. Just as lectures do not constitute the whole of university teaching, so there are usually other elements in teaching situations which the media cannot themselves provide. There is little feedback to the media teacher, and no personal contact which might help to motivate students. The mass media cannot take much account of individual differences. Nevertheless the media can contribute towards adult teaching, and faced with pressures of expansion, educators can hardly ignore them as a resource.

4.32 Distribution of communication

The mass media can distribute teaching and information over wide areas with great ease. This is truer of radio than television at present, but with the advent of communications satellites, television distribution should cease to be a problem. In countries where distances are great and the population scattered, and other communications may be poor, the media can help to overcome this distribution problem.
It is not only developing countries which have these problems: a comparatively developed country such as the U.S.S.R. can suffer from urban imbalance in educational provision. Prosser notes that radio and television are sometimes the only way of reaching village students in Africa. If the mass media can help to distribute educational provision more evenly, then the better educational facilities in the towns may cease to be simply one more magnet drawing people off the land.

4.33 Updating and supplementing of existing provision

The electronic media can provide updating where print materials or teachers have become dated. In-service training for teachers is one form of this. Similar courses can be arranged for doctors and other professional groups. Obsolescence of training and information is more of a problem in developed countries. Erdos writes:

The increasing rigidity of technological change is now bringing such frequent changes in methods of work that the training which a person receives in his youth often no longer equips him for the span of his working life, and the need for retraining may occur at intervals during his working life.

The electronic media can provide centralised distribution of the most up-to-date ideas and information, whereas the print medium, in the form of textbooks, represents capital investment of a less flexible form; the revision of a television programme presents rather fewer difficulties than the revision and re-issuing of a textbook.
The electronic media of radio, television and film can also supplement existing provision in several ways. They can be used for 'enrichment' — providing information and experiences which the teacher himself could not present. This can take the form of documentary material, or dramatic representations:

Normally, in this type of situation, we use the word 'enrichment' and mean by this that the broadcast must provide illustration in sound or vision of an unusual type — for example, may recreate important historical events in dramatized form, or provoke an audience involvement or participation which could not be easily produced in any other way.

Cripwell reports that television helped him to reduce the drop-out rate in some classes. Puglisi states that her literacy campaign relied to some extent on the glamour of television to get audiences in the first place. Prosser believes that they can 'inject a more human element, and provide a stimulus to regular student study' in correspondence courses. The mass media of radio and television can also supply audio-visual, or nonprint instruction where this is absent in the existing provision.

4.34 Reaching a new clientele

There is evidence to show that the clientele reached by present adult education provision is limited by various factors. Considering three factors — education, occupation, and income — Johnstone and Rivera report:
Taken together, the impact of all three factors was enormous; a person who had been to college, who worked in a white-collar occupation, and who made more than $7,000 a year, was about six times more likely to have been engaged in learning pursuits during the previous year, than a person who had never gone beyond grade school, who worked in a blue-collar occupation, and whose family income was less than $4,000 a year.

This refers to the U.S.A.; in Britain, Trenaman found evidence of an educational hierarchy, 'rich and complex at the top, impoverished at the bottom'. He concluded:

The whole further educational provision (the informal as well as the formal aspects) is a reinforcing rather than a remedial process. Thus, the proportions of people undertaking any kind of further study or training (even including craft and recreational classes) range from over 90 percent of those who reached the top forms of grammar schools to 10 percent of those who left elementary schools.

Trenaman suggests various reasons why this should be so. The selectivity of our educational system may produce a reaction against the system, 'so that the majorities who are continually rejected, come to resent the system which has excluded them'. In addition, he argues that these majorities may belong to a cultural tradition which is less verbalized, more practical and direct in emphasis than the present educational provision. Rowntree also has suggested that for people with little formal education, the words 'education' and 'culture' are coloured with certain associations, and although they do want to be informed, they shy away from formal educational institutions for this reason.
Trenaman's final point is that the mass media, because they are not so closely associated with the traditional provision and also because they are relatively less verbal and print-based, may be able to reach a wider clientele than formal education reaches.

The most hopeful possibility is that the informal agencies, broadcasting, the press and the public library service, which the present study has shown to have independent effects upon attitudes and which reach far beyond the limits of formal education, could both prepare the ground and make direct contributions. Such an informal service as broadcasting is especially suited to this purpose, for it can most easily reproduce the remaining traces of popular culture, and so help common people to build upon what is peculiarly their own.

Trenaman's argument is that in addition to their intrinsic value as teaching devices for the reasons listed above, the mass media by virtue of being free from formal educational associations, can reach out to a much wider spread of the population than the proportion who engage in adult education currently. This argument raises once again the relationship between the media outside education and the media used in education, and it is now time to consider this relationship in the light of what has been written so far.

Conclusion: Adult Education and the Mass Media

Verner's definition of adult education, quoted at the beginning of this chapter, emphasized the planned and systematic nature of adult instruction.

Whatever the form, content, duration, physical setting, or sponsorship, an activity is identified as adult education when it is part of a systematic, planned, instructional program for adults.
It was noted at the beginning of the chapter that the adoption of this definition meant that debate about the content or objectives of adult education became a debate about priorities within adult education, rather than about the nature of adult education. A similar point can be made in relation to the mass media. The mass media are intrinsically neither educational nor non-educational; it is their use in a systematic, planned, instructional program,¹ which makes them educational media. According to Verner's definition, it is therefore the way the media are used, rather than the sensory or other features of the media, which determines whether or not they become educational devices.

This point has implications for the arguments used for and against the utilization of mass media in adult education which have been reviewed in this chapter. Two basic types of argument have been examined. The first is an argument by analogy. In this case, it is argued that since the media are powerful or effective in mass communication and entertainment, they either are or are not suitable as teaching aids. It was suggested that this argument is based on assumptions about the effects of mass communication which appear to derive more from literary-based study of mass culture than the work of social scientists. The positive conclusion of this argument is contained in the preface to Groombridge's book *Adult Education and Television*:

Clearly television had to be taken into partnership and its power harnessed for the purposes of information and leisure-time amusement, and if possible, for the education of adults and children.

¹87
It is assumed here that television has a certain power, and that this power can be harnessed for educational ends. The negative conclusion of the argument is based on the assumption that since the mass media are effective at entertaining and informing people, this effectiveness must have something to do with the intrinsic nature of the media; they are therefore intrinsically unsuitable for educating people.

The second line of argument does not use the analogy of mass communication, but is based on a considerable amount of research evidence that the mass media, that is, radio, film and television, can teach as well, over short periods, as contact teachers, especially if they are used in combination with other teaching elements. Wiltshire's conclusion has already been quoted: there is no point doing more research to see if it works; it does.

In terms of Verner's definition, the first of these arguments, which uses the analogy of mass communications, is suspect. In this argument, the common element (the medium) is abstracted from two differing contexts: mass communication, and adult education. The existence of an analogy depends on the common element being stronger or more important than the differences between a planned and systematic course of instruction, and an evening's entertainment or informative broadcasting, are too great to be ignored. A planned course has definite aims and objectives; it takes account of the state of knowledge of the learners at the outset; it may allow for individual differences; it provides feedback to the learner, and may utilize
not one but several media and other means of instruction. Above all, both teacher and student are conscious that instruction is taking place. By contrast, any learning that takes place in the normal run of broadcasting is less conscious, and probably not planned; the mass media cannot take account of individual differences, and there is very little opportunity for the learner to respond actively to the stimulus, or obtain feedback about his own learning. Given such different sets of conditions, it is difficult to see how one can talk simply of the 'power' of the media.

As noted at the beginning of the chapter, the print medium is atypical in that it tends to be differentiated by form and format whereas radio and television are not. Rather than referring to the mass medium of print, it seems more natural to refer to the popular press, or the popular novel. This is not, in fact, a classification by form, but by audience and content. The cheap novel may have exactly the same format as a textbook; an academic journal may have a format not unlike a comic. Newspapers do have a distinctive form, but within that, a 'popular press' and a 'quality press' can be distinguished. The distinctions between the various forms of the print medium are based on the contexts in which they are used, and the kinds of use to which they are put — study, light reading, periodic reading, etc. The print medium provides a more revealing example than the other mass media do of the limitations of the argument by analogy. It is not suggested that because detective thrillers
and the works of Proust share the same kind of format, the latter will be read as widely as the former; or that because serious journals sometimes look like women’s magazines, they must be shunned. It is one thing to say that a medium may be used in education, it is another to argue its effectiveness is independent of content and context. The implication of this is that less attention should be paid to medium and more to the context in which it is used.

Support for this view comes from Trenaman's research on the effectiveness of various factors in the mass media. This showed that the factors affecting learning lie chiefly in the message and the recipient, rather than the medium. In the message, the factors are concreteness, dramatic intensity, personification, vocabulary difficulty and the number of major points. In the recipient, the principal factors are occupational level and interest in the programme. In conclusion Trenaman writes:

> The general equivalence between the spoken and written word in power of communication has been demonstrated in many previous studies, and a number of film studies have shown that there is also a general resemblance in what could be communicated by film. It now appears that television communication, too, is probably controlled by a common complex of factors producing wide differences of comprehension, but doing so in all verbal media alike, or nearly alike.

> One implication of this conclusion is that those factors must be sought in the qualities which all three (or four) media have in common.

> Trenaman’s findings have the effect of minimising the differences between media, and turning attention to what the media have in common.
It has been argued in this chapter that the mass media cannot usefully be abstracted from their context, whether it is the context of mass communication, or of formal education. The difference between the two contexts lies in Verner's emphasis on the systematic nature of adult instruction. Faced by what some writers have seen as competition from mass communications, a number of teachers have argued that the mass media should be used for educational ends. It has been suggested that this reasoning ignores the difference between the two contexts.

These differences are not primarily differences of content, sponsorship or audience. An 'educative' documentary programme may cover much the same ground and be broadcast by the same organization to the same audience as an educational programme. The difference lies in the framework within which the educational programme operates. This may not affect the design of the programme, but will affect the context in which it is presented; for example, it may be accompanied by a booklet, or form part of a more extensive course which includes correspondence lessons or direct teaching. The essentials of such a systematic framework will be outlined in the next chapter.

Even if the differences between the contexts of mass communication and systematic adult instruction were unimportant - and it has been argued that they are not - an approach to the design of courses based on the premise that the mass media should be utilized is arguably misleading in itself,
since it takes as a starting-point an educational means (the media) rather than an educational end (teaching objectives). The implications of such a 'media-based' approach are explored in the next chapter, in which different ways of formulating the relationship between the mass media and their educational context are examined.
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CHAPTER TWO

MEDIA, AIDS AND SYSTEMS

1.1 Mass Media and Other Media
1.2 Media, Aids and Systems

2.1 Devices as Aids
2.2 The Teacher-Centered Approach

3.1 Devices as Media
3.2 The Media-Based Approach

4.1 Media and the Systems Approach
4.2 An Outline of Systems Theory
4.3 The Systems Approach: Application to Education
4.4 The Systems Approach: Application to the Design of Instruction
4.5 The Systems Approach and Adult Education
1.1 Mass Media and Other Media

The first chapter was concerned with the media of radio, television, film and print, and their dual role as mass media acting outside formal education and as teaching devices used in education. It was suggested that the first role may have influenced the second, and that arguments about the use of the mass media in formal education were sometimes based not on empirical findings about their teaching potential, but on assumptions about and reactions to their effects on mass culture.

These mass media have, however, been the only new devices contributing to change in adult education\(^1\). A large number of other new devices have become available in the last fifty years. Balanoff\(^2\) lists among these the still camera, the overhead projector, the opaque projector, the filmstrip projector, the slide projector, the tape recorder, teaching machines, computers and multi-media devices\(^3\). Others can be added to this list: the record player, the language laboratory, the feedback classroom, closed-circuit television, information retrieval systems and a variety of educational games and models. Even an everyday device like the telephone can be used, if amplified\(^4\), and there is the prospect of electronic video recorders being on the market soon\(^5\).
This substantial inventory, added to the traditional and familiar devices of blackboards, textbooks and visual display in the form of maps and drawings, means that potentially the contemporary teacher or tutor has a much wider range of options in the devices he uses than he had at the beginning of this century.

It was useful to start, in the first chapter, with the mass media, not because they are necessarily the most effective or useful of the new devices, but because it is they which appear to have attracted most attention and aroused the strongest feelings, thus highlighting some of the problems involved in using all new media which might otherwise have remained obscure. In particular, because of their association with external, non-educational elements, they raise the question of the relationship between the teacher and the devices he uses. This problem arises with the use of any device, but becomes especially important when the relationship between the classroom teacher and the television or radio teacher is considered. The Year Book of Education, discussing the mass media, stated:

These and other media can quicken the interest and widen the experience of the pupil in a manner that no teacher could achieve without their aid. It is not intended, however, that they should supersede him in the classroom.

Some adult educators seem to believe that the media are quite peripheral to the real business of teaching and learning; others assert that they 'have a key role to play'.
In this chapter, three ways of conceptualizing the role of these devices will be examined: as educational media, as aids to the teacher, and as elements in an instructional system.

1.2 Media, Aids and Systems

The first two of these terms—media and aids—are sometimes used interchangeably. Thus Bruner, under the heading 'Aids to Teaching', writes:

There has been a great deal of discussion in recent years about the devices that can be employed to aid in the teaching process. These devices are of many kinds. Some of them are designed to present material to the student of a kind that would not be available to him in his ordinary school experience. Films, TV, micro-photographic film, film-strips, sound recordings, and the like are among the devices ordinarily employed in such work. Books also serve in this role.

Here, the devices are being described as aids. A very similar list, this time described as educational media, is given by Biddle and Rossi:

A striking variety of devices have been claimed as educational media at one time or another, including television, books, maps and globes, visual aids, language laboratories, teaching machines, chalkboards, and even pencils, papers, desks, lighting, or subject matter.

The third concept, that of an instructional system, can be seen partly as the outcome of a tension between the first two, instanced by the following passage in a recent UNESCO report:
The media are not merely aids to the adult educator, but educational agents in their own right. Like other forms of adult education, they have their specific limitations (one-way communication, centralized production, need for technical infrastructure, for distribution and reception, etc.). Their full effectiveness depends therefore upon integration into a comprehensive method of adult education.

Where the UNESCO report uses the word 'method', it might be clearer to use the word 'system', and in fact the report goes on to discuss the 'systems approach' in adult education. The terms 'aids' and 'media', although often used loosely to refer to the same devices, imply different approaches to the use of these devices. In this chapter, the advantages and disadvantages of all three approaches will be examined.

The implications of thinking in terms of educational media have already been discussed in the first chapter, and this chapter will examine further the 'media-based' approach. But it should be clear from the first chapter that the analysis of terms like these is not an academic quibble; the words represent viewpoints and traditions, and the interests of professional and commercial groups. Saettler has traced the rise and fall of various educational movements associated with particular devices like instructional radio, or particular concepts, like audiovisual instruction. To some extent, the concepts being examined here have been institutionalised in organisations such as the National Council for Audio Visual Aids in Education, the American Department of Audio Visual Instruction, the Australian Radio University, and the Centro di Telescuola in Italy. The newer National Council for Educa-
tional Technology in Britain, represents an attempt to think and work in terms of the systems approach. An historical analysis, however, apart from being too extensive a task in this context, might give the impression that through a gradual dialectic, the systems approach had eventually come to replace the other two, whereas some of the quite recent quotations given in this chapter show that the concepts of aids and of educational media are still very much in use.

It seems best in this case to argue the case for one or other of the concepts on conceptual rather than historical grounds. In deference to history, however, the analysis will be in the order in which the concepts appeared, that is: aids, media and then systems.

2.1 Devices as aids

'Aids' have been so closely associated with 'audiovisual aids' that it is difficult to disentangle the two ideas.

As Saettler has shown, the audiovisual movement, which can be traced back as far as 1886, laid stress on the use of objects, or pictures of objects as opposed to the verbal description of objects. It can be seen as an attempt to remedy too much verbalisation in education, and to deal more with 'concrete' things. Dale's 'Cone of Experience' is a graphic expression of this preference for 'direct, purposeful experiences' rather than mere 'verbal symbols'. Nonprint aids, such as wallcharts, models, pictures, films and slides, were seen
as valuable experiences for the learner, being 'closer' to direct experience than the descriptions found in textbooks. The habitual association of the word 'aid' with audiovisual devices, which could only ever form part of the total repertoire of devices, may have given it a particular aura of marginality.

The function of the aid is to help the teacher in his work. The main advantage of using the term lies perhaps in the realisation that aids do exist, and that the teacher can supplement his own powers by using various devices, not confined to the traditional textbook and blackboard. At its best, the concept of aids encourages the teacher to make use of a wide variety of things to extend and enrich his teaching: slides or films of other countries, tapes of plays or dramatic readings, charts and models which show the workings of complicated machinery.

The drawback to this approach lies in the suggestion that aids are somehow extras, which it is good to have, but possible to do without. If an aid helps the teacher to teach, it follows logically that the teacher can teach without it, if need be. It is left up to the teacher to decide whether to supplement his teaching in this way or not. This reasoning is partly due to the association of the word 'aid' with 'audiovisual aids'. It is possible for the teacher to work without using audiovisual aids (slides, films, tapes, display material etc.). It is much more difficult to teach without using any aids whatsoever; that is without even using a blackboard or a book.
To conduct an entire course in this fashion, without any use of aids, would seem nowadays to be putting an absurd burden on both teacher and student. But the picture, however strange, makes a basic point: that anything the teacher uses besides his own person, can be thought of as an aid to teaching. The idea that aids are marginal to the process of teaching is based on too narrow a conception of aids.

2.2 The Teacher-Centred Approach

There still remains a more fundamental objection to the concept. This, as Heinich points out, is the treatment of aids as devices which help the teacher to teach, rather than teach themselves.

Traditionally audiovisual materials have been considered solely as "aids" to instruction. The literature of the field bears ample testimony to the basic position that the goal of media is to "help" the classroom teacher. During World War II great reliance was placed on audiovisual materials to carry a large share of instruction. But even here stress was placed on the concept of "aids" to instruction:

'Multi-sensory instructional materials should be conceived as aids rather than as self-contained teaching devices. Official statements of training doctrines in the armed forces have consistently emphasized the point of view that all kinds of training aids and devices should be used as aids and not as teachers'.

The real drawback to the concept of the aid is that it leaves the role of the teacher unanalysed by suggesting that aids and teachers lie in quite different categories: the first is used by the second.
It may be clearer to distinguish between two roles which the teacher can have. The first is that of a manager of the learning situation. As such, it is his job to organize the resources at his disposal, which will include men, machines, learning materials and facilities, to produce the best opportunity for each individual learner to learn. This job may include setting objectives and creating tests for each course, and taking responsibility for the overall design of the course. Hoban believes that the introduction of new materials and equipment into a course makes this management function more important:

There is some reason to believe that the problem of management of learning becomes more acute when any aspect of new technology is introduced into education. Programmed instruction, for example, involves a high degree of control of the stimulus-response-reinforcement pattern and frequently also a high degree of permissiveness in rate of progress of the learner. The former removes the classroom teacher from the direct teaching process, and the latter performs the teachers' functions so that the management of learning on the part of the classroom teacher involves a new set of clerical activities, a new type of broad programmatic planning and administration, plus the introduction into the instructional program of a wider range of creative, analytical and interpretative activities.

Hoban seen the teacher's managerial role involving clerical work, course design and 'creative, analytical and interpretative activities'. Presumably these refer to monitoring of individual progress, and dealing with special problems or opportunities when they arise. In this managerial role, the teacher organises and deploys his resources.
In the second role, the teacher himself becomes a resource involved in the 'direct teaching process' mentioned above. This is the familiar role of the teacher as lecturer, class-teacher, discussion-leader and tutor. This can be referred to as 'contact teaching'. It is in this situation that the teacher and his aids are in the same category, for each can be viewed as a resource. Decisions about the use of aids — or the use of the teacher — involve comparisons between one and the other, or at least facets of one with facets of the other.

Some examples may make this comparability clearer. If part of a course involves constant repetition and practice of a small unit, perhaps a sentence pattern with substitutions, or typing a number of letters in a certain order, the teacher in his capacity as manager may decide to use a tape or film loop to teach this, rather than use himself as contact teacher. This might be because he finds he tires quickly of repeating himself, or because he finds that tape and film loops teach this unit more effectively than he can. Or he may argue that the use of mediated teaching in this unit releases him to perform other tasks, like individual tutoring, which he considers are more valuable. In this case, he is comparing his own capacity to repeat certain activities with the capacity of the tapes and film loops.

In another case, he may decide to distribute a mimeographed paper, rather than deliver a live lecture covering the same ground. Various factors might influence this decision.
The fact that the paper can be used for reference, as well as for the initial reading, may bias him against delivering a lecture, which cannot be referred to, unless tape recorded. He may feel that a print presentation will allow him to structure and organise his material more clearly, whereas a temporal sequence, however carefully planned, may confuse some of his audience. He may feel that the time taken in delivering the lecture — perhaps on several occasions — is better spent in leading discussions based on the previously distributed paper. On the other hand, he may consider that only a dramatic, live presentation can do his material justice; he may value the opportunity at the end of the lecture for people to ask him questions. He may want to establish his personality with the audience; on the other hand, if he is the retiring sort, he may prefer to meet them in small groups.

In this apparently simple decision a number of factors can be taken into account, without even touching on other possibilities based on the use of 'aids': audio- or videotaping the lecture, using visual aids to augment the lecture, or taping the lecture on audiotape, with accompanying slides for group or individual presentation. These decisions involve comparisons between the capacities of the lecturer and the capacities of the 'aids', as regards storage and presentation of information, sensory models, the amount of interaction achieved with the learners, motivating power, etc. It is clear that in decisions of this sort, certain facets of the
teacher, are being compared with facets of the 'aids'. The idea that there is a qualitative difference between the teacher and the aids he uses, can be ascribed to two things: the fact that the teacher normally combines many more of these capacities in himself than any one aid does, although the aids may be better at doing particular things, like repeating information, or storing information for easy access, and the undisputed role of the teacher as the overall manager of the learning situation: a role which involves 'creative, analytic and interpretative activities'_, which appear to be far beyond the scope of any mechanical aid at present. The use of the word 'aids' whether audiovisual or not, obscures the fact that the teacher has two roles, as a manager and as a resource.

It is of course possible to talk of aids as aids in the teaching process, rather than aids to the teacher. Bruner writes:

A discussion of teaching aids may seem like an unusual context in which to consider the teacher's role in teaching. Yet, withal, the teacher constitutes the principal aid in the teaching process as it is practiced in our schools.  

This is confusing: an aid must be an aid to something, as well as in something. If it is an aid to teaching, then the teacher can hardly be an aid to himself, except by distinguishing between the two roles of the teacher as was done above. It seems more satisfactory to abandon the word 'aid' altogether, and to talk of managers and resources.
The logical results of the teacher-centred approach can be summarised here. The connotation of marginality that the word aid has, means that the use of devices, other than the traditional ones of textbooks and blackboard, will appear to be a luxury rather than an essential. The additional distinction between 'audiovisual aids' and others, besides being illogical — print is visual and speech is aural — sets up an artificial distinction between older and newer devices. The marginality of aids suggests that they will be used piecemeal and unsystematically, thus altering the basic teaching pattern little. The artificial division of resources into the teacher and all others, means that the best deployment of resources may not be made. Finally, there is a confusion between the teacher's overall managerial and planning role, and his role as a contact teacher or tutor.

3.1 Devices as Media

The difference between the teacher-centred approach and the media-based approach is contained in a sentence in a UNESCO report already quoted: 'The media are not merely aids to the adult educator, but educational agents in their own right.' The sentence avoids a direct assault on the teacher's role by using the neutral word 'agents', but Heinich is more explicit, Referring to packages of educational films, tapes and texts, he writes:

To refer to the examples cited as "aids" to instruction is less than inadequate, it is deceptive. These are instruction. And we suddenly realize that we are buying teachers — not materials.
These new materials, which use the media as a means of presentation, are thus on a par with the classroom teacher, not simply devices for extending or supplementing his teaching.

The main advantage of the 'media-based' approach is that it allows teaching materials their rightful place as direct educational agents. This opens the way to a greatly increased use of mediated teaching, whether by television, radio or other media:

The number of mediated teachers will increase dramatically in the next twenty years. Ten years ago there were only a few around, but with the growth of ETV stations, closed-circuit systems, programmed instruction, etc., the numbers are increasing rapidly. It is entirely possible that in twenty years one third, or more, of the professional staff in this country will not come in face-to-face contact with students in the normal course of their instructional activities. They will be in mediated form.

Whether Heinich's predictions here prove to be correct or not, it is clear that there are some advantages in using mediated teaching rather than the classroom teacher. With proper access and study facilities, it can allow more independent study; the student can go at his own time and convenience to study centres rather than being tied to rigid classroom and group schedules. Mediated teaching, in theory anyway, should allow the student the chance of having well-planned, carefully tested instruction by some of the best teachers and programmers available. If a mediated course is going to be used by thousands of students, much more time and money can be spent on its preparation than the classroom teacher can devote to preparation for his class of thirty, or the adult tutor for his smaller evening class.
Where teachers are scarce, either in general or in particular subjects, or where they are not well distributed in the country, mediated teaching using radio, television, print and film can fill the gaps.

Heinich notes that awareness of the possibilities of mediated teaching which was not simply a supplement to the classroom teacher, grew with the development of educational television, film, language laboratories and programmed learning. This suggests two of the drawbacks of using the term 'medium'. The first is that it tends to set up a distinction between print and electronic media.

The phrase "new media" became current in the 1950s with the rather spectacular development of educational television and the growth of interest in programmed instruction and teaching machines that began in the middle of that decade. Since the term was also applied to the more conventional audio-visual devices, it was used as a convenient label for a wide range of instruments of modern technology that were applied to instructional procedures. The weakness of the concept was and is this: It splits the technology of communication down the middle — with print and lithography on one side and the audio-visual and electronic media on the other.

Although Brown and Norberg suggest that the newer term 'educational media' can overcome this split, it seems probable that the term media will continue to connote the new electronic media. For example, a recent book on media in higher education contains chapters on audio-visual equipment, the feedback classroom, television and the language laboratory, but nothing on print as such. This division can become institutionalised in separate library and media centers within one institution, producing tensions between librarians handling print materials, and those handling tapes, films and slides.
The second point raised by Heinich's observation is that the meaning of the word has become extremely vague. Some of the difficulties of definition were discussed in the first chapter. The fact that both Heinich and Brown and Norberg put programmed learning along with television and other media, suggests a usage so wide as to be confusing. Programmed learning can be seen as either a technique for producing materials, or a type of materials with certain characteristics, but can hardly be considered a means for transmitting or storing information. Programmed learning can use various media — television, radio, print — as means of presentation, but cannot be called a medium itself. Rossi and Biddle's book *The New Media and Education* contains chapters on 'Simulation and Games', and 'Programmed Instruction and Teaching Machines'. Again, this raises the question of the meaning of 'medium'. These two drawbacks, the split between print and electronic media, and the vagueness of the term, could be overcome with care. There are, however, two more basic objections to the media-based approach.

3.3 The Media-Based Approach

The media-based approach to educational development can be exemplified by several quotations. The first of these is referring to education in general:

Modern media, as they are coming to be used by education, will inevitably not merely cause changes; they will bring about a revolution, already begun, in the educational system as we know it. Prior to the use of print, education was a wholly differently organized process from that which we know today. In freeing
education from the rigid patterns imposed by print, the new media coming into use promise far more fundamental changes than most educators even today foresee.

The second quotation, from an article by Malcolm Knowles, comes at the end of a list suggesting possible ways of increasing the impact of the newer media on adult education.

When enough people become concerned with the more effective use of the newer media for the education of adults, and their ferment produces enough workable new approaches, then perhaps the newer media will indeed make an impact on adult education that will enable it to fulfill its potential as an instrument of individual and societal growth.

Knowles is talking about adult education in general; the third example, already quoted in the first chapter, is concerned with formal adult education: the original proposal for a 'University of the Air'.

In the educational world, as elsewhere, technological discoveries are making a profound impact. Television and radio, programmed learning and a wide range of audio-visual aids have already brought about considerable changes. The most important, undoubtedly, is that the best of our teachers can now be made available to vastly wider audiences. A distinguished lecture that at one time might have been heard only by a handful of students, or a few hundreds at most, can now be broadcast to millions of listeners. It has, therefore, become possible for the first time to think in terms of a University of the Air.

These quotations have certain things in common, and show several aspects of what can be called a media-based approach. The first, and most important, characteristic is that they make the media, rather than any educational problem, as their starting-point. The media are viewed as the initiators of
change, it is they that make an impact on education. This impact promises to bring about very important changes; indeed, in the opinion of the first writer, a revolution. These changes may be so fundamental that educators cannot even foresee them.

This argument goes very much farther than MacLean's assertion that 'television will present us with new teaching techniques we haven't even thought of yet'; it depends on a particular interpretation of the word 'technology', and a particular view of the role of technology in social innovation. 'Technology' as it is used in the third quotation is more or less synonymous with 'newer media' or 'modern media' in the first two. As Apter points out, this is one possible use of the term. In the above quotations, technology, used in this sense of media, or hardware, is seen as the prime agent of educational change. This is supported by a doubtful historical argument: 'Prior to the use of print, education was a wholly differently organized process from that which we know today'. This is quite true, but it does not follow that all the changes which have taken place in education between the invention of print and the present day, are due to that invention alone. The argument is used to suggest that the introduction of new media can bring about equally basic changes. There is no mention of other factors that might influence the direction of education; changes in the curriculum, in the numbers and ages of people who are studying, in the institutions which provide education.
A second argument which supports this view of media as change agents, is the argument by analogy noted in the first chapter. The mass media are assumed to have considerable effects outside education, therefore they can have just as much effect within education. Thus in the third quotation, it is asserted that a distinguished lecture can now be broadcast to an audience of millions. This is true, but omits two important qualifications: the number who listen to it may be rather smaller, and the number who can be shown to have learned from it, may be even smaller still. The fact that a lecture is broadcast does not automatically ensure that it will teach people effectively.

The dangers of this view of media is that it raises educational means to the status of an end. Instead of the media being used to solve problems which have been identified beforehand, the use of the media now becomes an end in itself. This appears in a curiously ambiguous paragraph in a recent UNESCO report:

From the point of view of adult education, the media are basically tools for solving problems and should be used fully whenever they may be expected to make a valid contribution towards the resolution of fundamental educational tasks. New technologies are not ends in themselves: to make the fullest use of their possibilities, it is necessary to devise the most varied educational uses for the new instrumentalities, as they become available. 40

Up to and including the sentence 'New technologies are not ends in themselves', this statement seems to put media firmly in their place as means towards solving problems.
But the last sentence suggests that the order should be reversed, and that as the media become available, use for them should be created. As a research strategy, confined to a few centres which investigate the new media as they are produced, this is justifiable; but applied generally, it leads to the unthinking installation of expensive closed-circuit television systems or language laboratories.

Although the new media may act as a catalyst in teaching, the effects of their unplanned introduction into a teaching framework is just as likely to be counterproductive. There is pressure, because of the heavy investment involved, to make use of the plant on all possible occasions. Suitable materials or software for this equipment — tapes, slides, programmes — may not be available, and teachers may not have enough time or incentive to prepare them. Full technical support may be lacking. The general belief in the power of the media to change things, evident in the first quotation, is no guarantee that the new media will not be either misused or underused. The fundamental defect of this media-based approach is that it confuses the solution with the problem. The introduction of new media in education is not in itself the basic problem, although it may entail problems; the problem is to help people to learn. The new media may be part of a solution to that problem in certain situations, but in themselves, they do not provide a rationale for their own use. That can only come from a consideration of the total framework of the course.
4.1 Media and the Systems Approach

One of the clearest examples of a 'systems approach' to the use of media occurs in a passage in a Council of Europe book on Direct Teaching by Television. Discussing television, the report says:

It was the unanimous view of the Seminar that it (television) can most fruitfully be employed as one element in a combined operation or articulated instructional system, to be used as the situation demands (and as resources allow) in conjunction with any or all of the following other means of education:

a) correspondence tuition
b) ancillary printed material (including teachers' guides, pupils' pamphlets, textbooks and worksheets);
c) group discussion
d) full-time or part-time face-to-face teaching.

None of these elements should have an automatic primacy, and one or another of them may be dominant in relation to the needs of a particular situation. What is essential is that the teaching operation should be planned as a whole, with each of its elements working in harmony with the others.

The most important part of this statement is not the fact that it envisages a multi-media approach, i.e. the combining of various media in the optimum mix. This is indeed an advance on the earlier approach which tends to view a particular device as the solution for any problem. Each medium has strengths and weaknesses, and it seems sensible to explore these so that the advantages of one can compensate for the limitations of another. This in itself is still, however, a 'media-based approach' since it does not make reference to any criteria for selection beyond the media themselves.
The difference in the above passage is that it introduces factors other than the media: the demands of the situation and the availability of resources. It relates the use of the various teaching devices and methods to the 'needs of a particular situation'. This means starting from scratch, and working out the objectives of and constraints on a particular course. Thus the teacher is engaged in designing and developing an 'instructional system'\(^\text{45}\), which takes into account not only devices or media, but objectives, resources, the student intake, materials and methods, and the techniques of evaluation. Before examining the design of instructional systems in more detail, it may be useful to look more generally at 'systems theory'.

4.2 An Outline of Systems Theory

As von Bertalanffy notes at the beginning of a recent book, the word 'system' is ubiquitous:

If someone were to analyze current notions and fashionable catchwords, he would find "systems" high on the list. The concept has pervaded all fields of science and penetrated into popular thinking, jargon and mass media. Systems thinking plays a dominant role in a wide range of fields from industrial enterprise and armaments to esoteric topics of pure science.\(^\text{46}\)

Oettinger writes that education has been no exception to this:

There is today a widely held point of view from which almost anything, and education in particular, can be described as a collection or system of interdependent parts belonging to a hierarchy in which a system may have subsystems of its own while acting as a mere part of a super-system. The process of analyzing or synthesizing such systems, called "systems analysis" for short is touted as one of the shiniest of new technologies.\(^\text{47}\)
For all the apparent ubiquity of the systems approach, it is not easy to find a definition of 'system' which commands general assent. Certain features seem common. These can be summarized as follows:

1) A system is a whole consisting of interrelated parts; and although the parts can to some extent be treated in isolation, the main emphasis is on seeing each part within the general framework. Thus a system is organised complexity.

2) The boundaries of a system must be relatively clear, so that the system can be isolated from its 'environment' and treated as a unit. Closed systems have no interaction with their environment; open systems take in elements from their environment (input) and put back elements into the environment (output).

3) Systems tend to have goals which they exist to achieve. The nature of these goals can vary greatly, but it is important that they be measurable.

Summarising further from a number of writers on the subject, the main features of the systems approach appear to be:

1) An emphasis on seeing the whole, and seeing the parts as parts of a whole.

2) An attempt to specify goals clearly.

3) An attempt to identify constraints acting on the situation.

4) An overall empirical attitude which looks for the optimum argument of resources in relation to goals.
Put thus baldly, the systems approach appears to be little more than the application of common sense to complex situations. Indeed it is a feature of systems thinking that it is often either so simple as to sound trite, or so complicated that the lay reader is soon lost. As a generalised approach, it seems, as Oettinger notes, to enshrine reason, common sense and scientific method. In its particular applications to military and industrial problems, it appears both involved and perhaps inapposite to education.

At this point, it is necessary to distinguish between different tendencies within systems thinking. Bertalanffy distinguishes between a mechanistic trend and an organismic trend. The first of these, which is the better known, stresses control, feedback and mechanistic models of interaction:

The mechanistic trend is connected with technological, industrial and social developments such as control techniques, automation, computerization and their application for industrial, military, governmental, etc. purposes. The underlying theory is essentially that of cybernetics, automata, computers and similar "hardware". The enormous strides these developments have made are generally known and widely publicized, and so are its dangers.

Bertalanffy goes on to note that this 'feedback' model is in effect a development of the familiar psychological S-R (stimulus-response) scheme, with a feedback loop added to make the system self-regulating. Smith and Smith have investigated the applicability of this model to the design of learning, viewing the learner as a system who regulates
his own learning strategies according to the feedback he gets from the teacher or the materials about his own progress.

The other trend described by Bertalanffy, uses rather different concepts:

The "organismic" trend essentially starts from the trite consideration that "an organism is an organized thing" (the same applied to systems below and above the living individual); and we must look for principles and laws concerning "organization", "wholeness", "order of parts and processes", "multi-variable interaction" and so forth, to be elaborated by a "general system theory".

This trend, based on Bertalanffy's own work on biological systems, seems less rigid, but also less immediately clear. Nevertheless it does contain useful concepts. The notion of equifinality - 'the same final state or "goal" may be reached from different initial conditions or in different ways' - may be relevant to instruction. This second trend also seems to avoid the emphasis on homeostasis or equilibrium, which dominates some other systems thinking. In general this could lead to less concern with the reactive features of human learning, and more emphasis on selective and exploratory aspects:

Spontaneous activity is a consequence of the fact that the organism is an open system, being able to maintain a state distant from equilibrium, and to spend existing potentials either in spontaneous activities or upon releasing stimuli. Biological, neurophysiological, behavioral and psychological evidence equally show that spontaneous activity is primary and stimulus-response is a regulative mechanism superimposed on it. The organism is, therefore, not a robot or automaton, but originally holistic behaviour.
becomes progressively - and never completely - mechanized. The robot model should be replaced by one centred around the concept of system.

Bertalanffy's argument depends on findings in the human sciences with which this writer is not familiar, so no comment on them can be offered here. But, as Saettler notes (see below), the adoption of either a mechanistic or organismic concept of systems theory, does have practical implications for the design of instructional systems. Bratten notes that Bertalanffy's ideas have had considerable influence in the field of business management and social organisation in general, whereas the mechanistic concept has remained primarily with industry and defence.

Johnson and Miller give an account of the main elements of systems analysis. They identify five main stages:

1) Identify problem
2) Analyze problem and set goals
3) Determine solution strategy
4) Implement solution strategy
5) Determine strategy effectiveness.

There is a revision process from any one stage to the one before, and from the last one to any of the previous ones. The process is thus one of constant revaluation in the light of evidence about the effectiveness of the strategy chosen. All models of the systems approach seem to have this much in common. The five stages identified above can be reduced to three even more basic ones; the identification of a problem; the choice between alternative strategies;
and the evaluation of the result. Reduced to its simplest level, the systems approach appears as a unified approach to complex problem-solving. Once, however, a move is made towards its application, variations within this basic approach begin to appear. Some of these will be examined below, as the applicability of the systems approach to education in general and to course design in particular, is examined. At the same time, it is unwise to underestimate the possible influence of such a general approach to problem-solving. The very generality of the systems approach is its strength as well as a possible weakness, for if it can be applied at all, it can be applied to very different problems and on very different scales. Although, as Oettinger notes, there is no general body of well-defined and effective systems theory that may be applied by powerful computers to the analysis or synthesis of any system whatsoever, the existence of this general verbal model, may provide a framework for approaching educational problems. Bratten defines the systems approach at one point as an 'attitude or conviction'; the value of such a general model may be as a reinforcement, or point of reference, for a more empirical approach to educational matters.

4.3 The Systems Approach: Application to Education

Bratten traces the origin of systems analysis back to the development of weapons systems in the second world war.
Since then, he writes, systems thinking deriving from several sources including von Bertalanffy, has been applied to areas of defence, industry and management. The attempt to apply it to education is more recent; indeed Brown and Norberg argue that large-scale acceptance of it in education is still very much in the future. Bratten writes that the uniqueness of the systems approach may lie in the fact that it is being applied to areas of activity, which have not previously been approached in this way. Education may be one of these new areas. Criticisms of the systems approach to education turn therefore not only on the validity of the approach in itself, but on the question of whether education is a suitable area for its application.

Why is it necessary at all to try and apply it to education? The attempt can be viewed in several ways. Historically, it can be seen as an attempt to 'rationalise' education, in the Weberian sense. It is arguable that education, and higher education in particular, is still being influenced by organisational models that are now dated, in particular the craft guild model. From another angle, the systems approach can be seen as a result of education having become, in economic terms, a major industry. This has led to a search for better accounting and management techniques:

Pressure from the outside world towards ensuring that money is well spent has already led to changes in financial arrangements and an attempt to disentangle the cost of teaching from the cost of research in the universities. New kinds of questions are being asked,
for example, about the 'utilization of plant', implying a view of education as a knowledge industry to which notions of efficiency can be applied.

This view raises the question of how far models suitable for industrial analysis are suitable for education, and it becomes important to distinguish between different areas or levels of application of the systems approach within education. One of these levels is the course unit, and it is this that is the main concern here. At course level, the use of the systems approach can be seen as a response to the growing complexity of resources, outlined at the beginning of this chapter, and to other very basic changes taking place: in the redefinition of subjects and curricula, the increase in student intake and shortage of teachers. In this view, the systems approach is primarily a response to complexity, not qualitatively different from older procedures, but more systematic, more explicit and more empirical.

Most of the difficulties and objections to the use of the systems approach in education appear at course design level, and will be examined in the next section. It may be useful here to quote Brown and Norberg on one very general, but pervasive misgiving: that such an approach is too rigorous and rigid to suit an activity where human interaction is difficult to quantify.

The question of appropriateness come quickly to mind when one examines the common assumption that teaching is an art. If we combine this perfectly valid notion with the opinion that technology and highly contrived instructional procedures can only get in the way of the good teacher — as some do — it is not difficult to draw the somewhat analogous conclusion that systems
analysis is suspect and dubious and possibly actually threatening to highly regarded educational values. Of course, scientific "neutrality" and "cold" quantitative precision of operations research do not necessarily lead to denial of the importance of personal contact or other cherished values. Unfortunately, however, such erroneous reasoning continues to beguile many whose humanistic defenses are quickly triggered by the idea of "trying to reduce teaching to a set of mathematical formulas".

This tension between attempts to rationalise and to sustain an older approach, based on the view of teaching as an art or a craft, is part of the wider conflict caused by the impact of technology on our society. The degree of quantification which is thought necessary, depends in part on the extent to which a tight, centralised systems model is adopted, or a looser devolved one. The application of these models to course design is examined in the next section.

4.4 The Systems Approach: Application to the Design of Instruction

The procedure for developing the curriculum outlined by Taba is similar to the basic stages of systems analysis given above. She lists seven steps:

- Step 1: Diagnosis of needs.
- Step 2: Formulation of objectives.
- Step 3: Selection of content.
- Step 4: Organization of content.
- Step 5: Selection of learning experiences.
- Step 6: Organization of learning experiences.
- Step 7: Determination of what to evaluate and of the ways and means of doing it.
There is the same emphasis on an ordered series of steps, beginning with the identification of a problem, proceeding to the choice of alternative strategies and the implementation of one of them, and of the evaluation of what has been achieved. Other models of course development are available (see Figs. 4, 5). The National Council for Educational Technology model emphasises the cyclical nature of the process; evaluation can lead to modifications in all the earlier stages except in the initial identification of needs. The choice of learning resources, which includes selection, is seen as one stage in the total process, subordinate to the specifying of objectives. The difference between the systems approach and a media-based approach becomes clear here; the starting point in the former is a need or a problem; the media may help in teaching a solution. The media are thus seen as means to a specified end, and their use depends on the other stages in the process, as well as on their own relative strengths and weaknesses.

Fraut's model similarly emphasises a cyclical process of revision until all objectives have been achieved. The main question raised by this model is the exact relationship between the overall strategy and the various subsystems. Depending on how rigid, or loose the system model is, subsystems can be more or less open-ended. In the case where the model is a loose one, and some subsystems are not specified in detail, the freedom of manoeuvre gained thereby must be balanced against the possible disruptive effect on the system as a whole. This problem is discussed below in relation to Bertalanffy's distinction between mechanistic and organismic systems.
Fig. 4. Diagrammatic Model of a Learning System.
The foregoing models appear to be more explicit models of a process which it is arguable good teachers go through anyway. The difference between the system approach, and the old 'implicit' approach, appear to lie chiefly in two things.

The first is the application of specialised techniques at various stages in the process. Though these techniques are localized in the sense that they pertain to particular stages e.g. formulating objectives or devising tests, they may in practice affect the process as a whole. Thus the degree to which the designer can specify objectives behaviourally, in terms of performance, depends on the kinds of tests of performance that are at his disposal. Nevertheless the point remains that within the design of instructional systems, there are stages and subsystems which can be approached individually. Thus, in the identification of needs, course designers can conduct a form of market research to see what demands there was for particular courses. Where there is an element of supply and demand, as in evening classes, this might prove useful. The techniques might include interviewing, questionnaires and other techniques common in market research. In the next stage — the specifying of objectives — various taxonomies exist which help the teacher to formulate new objectives or categorize existing ones in a manner which will be generally comprehensible. In doing so, they may need to co-operate with specialists in educational testing, who can design appropriate tests for each sort of objective. Techniques for the analysis of materials also exist and the course designer can use these in selecting the materials he needs. As regards the choice of media, Briggs and others
have done work on relating media to course objectives and types of learning involved. Tosti and Ball have also identified important considerations of interaction between the presenter and audience. There is an extensive literature on testing and evaluation.

In sum, there now exist a whole range of specialised techniques which can be used at various stages of course design. It is unlikely that the teacher or tutor will have either the time or the expertise to bring all of these techniques to bear. Thus the development of instructional systems demands new breeds of educational specialists, who advise and help with particular stages of the design problem. This is another way of defining 'technology' in relation to education; not, as before, the uses of hardware, or technological products, in education, but the bringing to bear of specialised techniques on educational problems, and here on the problems of course design. The main difference between course development in the past, and as it may be in the future, is the degree of expertise used in relation to particular problems. The teacher or tutor in the past, who set about devising a course according to the precepts of 'good method' and in the light of his own experience, was an amateur; in some cases, no doubt a very good one, but restricted as to the scale he could operate on and limited by the scope of his own powers of analysis. More important, his successes and his experience remained local and would tend to die with him. The translation of these techniques into objective
knowledge which can be possessed in common and transferred from one situation and period to another means that much less of this expertise should, in the future, be lost; and that progress, based on the findings and the experience of predecessors, becomes possible.

This last point raises the problem of how far course design and teaching are explicable and formulable in terms of a series of related techniques. For if teaching and learning are not formulable in the manner described above, then what is passed on in objective form from one person to another has no more than the limited status of 'technique' in art; as, for example, the technique of harmonising in music to give particular tone colours, or of drawing in perspective. While such techniques do represent a progress in the arts, they do not enable the artist simply by learning them to compose a good symphony, or to paint a fine picture.

This is central to the second difference between the older implicit approach and new systems approach. The first difference lies in the application of specialised techniques at various stages of the process. The second difference is the degree of explicitness, or objectivisation which can be expected of the process as a whole. This affects not only particular stages, like the specifying of objectives, but the relationship between stages; to what extent one can derive criteria for choosing materials and media from the objectives that have been specified. This is a rather different matter from using techniques at particular stages. The problem of deriving media choices from, among other things, the types
of objective, has been approached by Briggs:

While one cannot directly relate classes of media with conditions of learning in such a way as to make choices simply by comparing two tables, it is believed that the examination of the required conditions of learning for each educational objective, along with other specifiable kinds of information, can result in an improved basis for assigning the media to be used for a set of objectives.

This is the problem; that it is not a simple one appears from the subsequent description of the dimensions of media stimuli:

One dimension may be the choice of audio, visual or audiovisual channels. The form may consist of words, symbols, pictures or signals. A third dimension is size, area, and amount of presentation to be given in temporal sequence, including intensity, color, or pacing of successive stimuli. The schedule of interruption of content stimuli to allow for responses, goal setting, and evaluation is another dimension in selecting media of presentation. Exposure rates, as in fast or slow motion and size of step in terms of rapidity of progression from simple to complex, constitute another dimension.

Such a range of criteria begins to raise the question: how practical is it to determine media selection on all these bases? Even allowing for the fact that there may be a team of design specialists working on the course in question, such complexity suggests that the work would hardly get started, let alone finished. And in discussing systems, practicability is something to be taken into account: time is a resource, and likely to be as limited as all other resources.

At this point it may be useful to refer back to the two generalised trends in systems thinking described above; the mechanistic, and the organismic. Saettler, discussing Bertalanffy’s ideas, writes:
A basic assumption of the instructional system development concept in this (Saettler's) book is that the teacher-communicator and the learner-communicants are the major components and are mutually interacting in a total communication situation. This is opposed to the theoretical notion that an instructional system is deterministic in the sense that the system is designed to change learner behavior in the desired direction by providing the right stimuli at the proper time. In this latter view, learning is nonpurposive habit formation, and habits are formed through conditioning which attaches desired responses to specific stimuli. Teachers who adopt this mechanistic approach to learning decide specifically what behaviors they want learners to manifest and then proceed in a systematic manner to stimulate them in such a way as to evoke and fix those behaviors.

Any reasonably complex system, however, requires a true interaction between teachers and learners so that new understandings can be developed or old ones modified. Understandings occur when the learner pursues his purposes and sees new ways of utilizing elements of his environment, including his own bodily structure. Some way must be found, therefore, for thinking about an instructional system as a mutual interaction process in terms of system goals.

Saettler is making several points here, of which only one is relevant to this discussion. That is his opposition of a deterministic model of instructional systems to one in which there is development and modification. This development takes place through 'true interaction'. What Saettler appears to be saying, and relates to passages in Bertalanffy, is that in an instructional system, there are areas of interaction which neither can nor should be pre-determined, but which still exist within a total determinable framework. These areas of interaction are best left to local control, which will have the on-the-spot information on which to base decisions which cannot be available to the planner.

One or two examples may make this notion clearer. In the design of educational materials, the designer can be furnished
with a fairly detailed brief. This will include the time available, the money and resources available, the intended audience, the range of content, the media to be used, the sequence of content etc. He may also have the opportunity of trying out some parts of his materials on typical learners to test for both general and specific effects. He is thus working within a broadly determined framework, and one which is much more rigorous than, say, the textbook writer is used to. But in the actual creation of the materials, the writing of paragraphs, the choice of slides and drawings, the format of the page, the producer of materials is probably best left on his own to get on with the job. This is a case of strong interaction, which cannot be analysed without damaging the interaction between the writer, his medium and his task.

Another example is a discussion class. The tutor has worked out, or has been given, a topic for discussion, and detailed guidance on the points that should be brought up and the overall style of the discussion. He may, for example, plan not to intervene much, and let the discussion go its own way. Discussions, by their very nature, cannot be planned in detail; they depend on interaction between members of a group. The tutor’s role must vary, in practice, according to the turn that the discussion takes. It cannot be entirely predetermined.

It is probably an injustice to systems theorists to suggest that their specifications of the ‘right stimuli at the proper time’ attempt to cover such minutiae. Nevertheless, in programmed learning, the control over stimuli and responses can be extremely tight, and the kind of control suggested by Unwin,
using computers, takes into account seven different factors (see fig.6). Again, the question is not only whether this is possible; it is whether it is practicable. The amount of time and money needed to programme a computer to take account of all these factors must be considered and even then it is debatable whether the learner himself, given some of the relevant information, might not be able to control the learning situation better himself.

The specification of all learning situations to such a degree of detail is questionable on two counts. First, in certain areas of strong interaction, it may be impossible to analyse what is going on without doing damage to the process. This is comparable to continually pulling a plant up to see how the roots are doing. The second drawback is a practical one of time and money; design which goes into such detail may not be feasible in the present circumstances.

It is unwise to be dogmatic in a development as new as the design of instructional systems. But a strategy can be suggested which will at least allow educators to get on with the job. The general arguments for a systems approach, rather than an approach which starts with media, or with the teacher, are strong. This is essentially a problem-based approach, which makes no prejudgments, or as few as humanly possible, about the use of resources involved. This approach provides a framework for course design which is much more detailed than anything in the past, and make use of specialised techniques at various points. Within this general design, however, there are recognised to be areas of interaction between elements in
Subject-matter
program

Item no. n
Student answers
in X seconds

Information on
student's previous
responses

Information on
student's time-table
study plan and
other administrative
requirements

Information on
student's I.Q.
and other
personality
factors

Decision on
appropriate course
of action made in
a fraction of a
second

Information on
time taken for
previous responses
and average time
for each response

Information on
possible answers
to each item

FIG. 6. A Model for Computer-based Instruction.
the system, where planning and control are devolved to whoever is locally engaged: the learner, the teacher, the television producer, the librarian, etc. Within the general framework of the system, this local agent takes decisions on the basis of his own judgment. These can be examined retrospectively, but cannot be planned in advance. Returning to Briggs' dimensions of stimuli, the division of control might be worked out as follows:

<table>
<thead>
<tr>
<th>Dimension of Stimulus</th>
<th>Locus of Control</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Course Designers</td>
</tr>
<tr>
<td>1. Choice of audio, visual or audio-visual channels</td>
<td>X</td>
</tr>
<tr>
<td>2. Choice of words, symbols, pictures or symbols</td>
<td>X</td>
</tr>
<tr>
<td>3. Size, area and amount of presentation</td>
<td>X</td>
</tr>
<tr>
<td>4. Intensity, color, and pacing of successive stimuli</td>
<td>X</td>
</tr>
<tr>
<td>5. Schedule of interruption</td>
<td>X</td>
</tr>
<tr>
<td>6. Exposure rates</td>
<td>X</td>
</tr>
</tbody>
</table>

This is not presented as necessarily the best division of labour, but simply to make the point that certain decisions can be devolved to the local agent.

It is misleading therefore to talk of objectivisation in systems designs as if it applied equally to all parts of the system. One of the most crucial parts is the specifying of educational objectives, and as Boudy argues, there may be limits to what can be specified. But the general point
still holds; the systems approach provides a balanced framework for design, within which more spontaneous areas may still be able to exist without disrupting the whole. The problem for course designers appears not so much one of specifying procedures for the whole course, as of achieving the right balance between pre-planned and locally controlled elements. The extent to which the teacher can be left free to exercise local control, will vary according to the aims of and constraints on the system. This concept of a balance between central, or source, control and local control will be a key one in the investigation in the next chapter of information systems in the instructional context.

4.5 The Systems Approach and Adult Education

The discussion of the systems approach in this chapter has moved almost entirely on a conceptual and theoretical level. It may be useful, therefore, in this final section to consider very briefly some of the practical problems and possibilities arising from the application of the systems approach in adult education. There is not room here to do more than raise the main points, and these will relate primarily to two questions; first, the degree of rigour with which the systems approach can be used, and secondly, possible objections and obstacles to it.

Hamreus, in a lengthy paper on instructional systems, outlines both detailed and simplified versions of the
systems approach. The second of these, which consists of six basic stages, is shown in Fig. 7. Referring to the detailed model, he suggests that the resources necessary to implement such a model may be available only in rare cases, and that for most instructional technologists, the simplified version may be all that is practicable. This point is relevant to the argument which has been advanced here, which is that the systems approach is basically a simple procedure, differing in degree rather than in kind from existing methods and procedures, but capable of almost indefinite deepening and sophistication. It is suggested that at various stages of course design, specialised techniques can be brought to bear which require the help of experts, and that a greater degree of objectification is attempted over the whole process of course design than has been expected in the past. However, it has been argued, following Oettinger, that the systems approach, at its simplest, is no different from applying common sense to the handling of a complex situation. The line between a systematic (i.e. simple version) approach and a systems (i.e. sophisticated) approach is a difficult one to draw.

The technological aura which, according to Oettinger, surrounds the systems approach may be unfortunate in that it could lead adult educators to postpone any attempt to systematise course design until the day when sufficient resources are available for the application of sophisticated techniques. In adult education, with its typically limited and scattered resources, this could mean indefinite delay. This may be a case
Fig. 7. Simplified Procedure for Developing Instructional Systems.
where the beat is the enemy of the good. It is the opinion of this writer that some improvements in the design of adult courses could be made without the advantage of greatly increased resources. These are the kinds of improvements which should result from a clearer specification of objectives, consideration and try-out of at least some alternative teaching methods and materials, and basic attempts to evaluate the results of the course. For the application of such a systematic approach, it is not necessary to hire a team of system analysts, or introduce expensive new media. What is essential is a more objective attitude towards teaching and learning, the time and incentive to step back from the course and appraise it, and a basic grasp of the steps in course development which have been outlined in this chapter.

There are two likely obstacles to such improvements. The first has to do with the role of the adult teacher. The re-design or development of an adult course may involve a change of role for the teacher, and this could lead to a sense of insecurity. At its most extreme, this is a fear that the machines, in the form of mediated instruction, are taking over, either by substituting for the contact teacher, or limiting his freedom in the class. Even slight changes, however, such as a shift from lecturing to discussion, can be difficult to make, especially if the first role has become familiar through years of work. The difficulties of adult teachers in making such changes should not be underestimated, and some sort of in-service support and guidance is probably necessary.
The second objection that may be raised to systematic course design is that the content of the courses and the style of adult education, do not lend themselves to rationalisation in this way. It may be argued that adult education has an essential informality and spontaneity that would be lost in the process of instructional analysis. More precisely, this may take the form of objections to the detailed specification of objectives, and to evaluating the outcomes of the courses.

It can be argued that the adult class should be left free to generate its objectives as it proceeds through the course, and that a prior specification of objectives will hamper this. This springs from a misconception about the nature of objectives. Objectives may relate not only to content, but to attitudes, manual and mental skills. The generation of new objectives during the course may in itself be a quite valid prior objective of the course, though it raises problems of priorities between objectives agreed on at the beginning of the course, and objectives generated during it. Possibly because traditional syllabuses have tended to confine themselves to content objectives, the specification of objectives in greater detail may suggest to some people an even greater dedication to 'material to be covered'. The objectives of an adult course might well include, as well as a factual content, the development of inquiry skills, the relating of the content to other situations, and other non-content objectives.
As regards evaluation, it may be argued that a greater emphasis on this will lead adult education to become as dominated by tests and examinations as secondary education is. Evaluation is necessary because decisions have to be taken, and it provides the necessary information for decision-making\textsuperscript{101}. However, these decisions may be of various sorts. In the school system, evaluation is geared to producing information for the selection of students. Much of adult education is not concerned with selecting and classifying its students, and does not need evaluation for this purpose. But decisions about courses and the allocation of teachers and resources do have to be taken, and evaluation is needed to provide the information for this. This is evaluation of the course, rather than of the student, and implies the construction of tests which measure not, for example, the learning of students relative to one another, so that they can be ranked, but measuring learning for different parts of the course. Much of this evaluation can be done relatively informally, without resorting to written tests. Better evaluation of adult courses should not necessarily lead to the rigidities of school examinations.

Even allowing for these misconceptions, there remains the uneasy feeling that systematic course planning must somehow lead to a loss of spontaneity. Ellul\textsuperscript{102} suggests that one of the characteristics of technology is that it converts unreflective and spontaneous behaviour into reflective and planned behaviour. This is not a question that this writer can resolve
here and it depends finally on the value adult educators, as a profession, put on rationality, in the form of systematic course design. A more systematic approach to instruction may lead to better instruction, through a combination of inspired common sense and specialized techniques. The problem is to know whether the detailed analysis of instruction, which is a feature of course design, can be resolved into a final coherent and stimulating product, much as the detailed engineering in an aircraft factory produces a graceful aircraft, or whether the habit of analysis will permeate the course itself, making it rigid, discontinuous, and merely functional. In the latter case, rationality, in the form of systems analysis, becomes not only a means but a habit.

The argument in these first two chapters can now be summarised. There is evidence in the literature of adult education of considerable interest in the utilization of the mass media for educational purposes\(^{103}\); one writer has identified the use of media and new devices as an important factor in the development of adult education\(^{104}\). It has been suggested that the roots of this movement to utilize the mass media may lie partly in analogies drawn from the field of mass communication and entertainment, in which, some writers have assumed, the media have direct and powerful effects. This analogical reasoning can be criticised on two counts. First, the analogy itself may be too imprecise to be useful; the differences between the contexts of mass communication and
formal instruction may outweigh the common element of the medium. Secondly, arguments based on the notion of making use of the media tend to promote a 'media-based' approach to course design and development, which takes one of the means (the media) rather than the problem (the objectives) as its starting-point. It has been argued that the availability of new media, including the mass media, creates a new degree of complexity and choice in teaching, and that only a systematic approach to the use of all these resources can result in effective use of them. In the past, when the choices were more limited, less explicit procedures could be used, but the present complexity demands an explicit and carefully staged process of decision-making which is known broadly as the 'systems approach'. The mass media, in this case, are not simply additions to existing resources; their use for instruction raises a number of questions relating to the role of the teacher and the rationale for the design of the course. They may act as change agents in adult education by creating new problems, which can only be tackled by systematically reviewing basic assumptions about adult teaching. In conclusion, it can be suggested that this potential role of the mass media as catalysts in adult instruction may be more important than their actual usefulness as teaching devices. Theoretically, the mass media may act as catalysts; this is not to say, however, that they will do so in practice.

A framework has now been established within which the examination of one mass medium, print, can take place.
In this, the technical potential of the book will be examined. It may appear strange to talk of the 'technical' aspects of book, although not so with newer electronic media like television. However, in the light of what has been written in these chapters about the definition of the word medium, the book will be regarded as a device which has certain facilities. In particular, the facility which is of interest here is that of easy access; the reader can turn almost as easily to any page in the book, as to the next page or the preceding one. This simple feature of books allows readers either to read them serially, turning always to the next page, or selectively, turning to different pages. This means that there can be two principles of organisation of the content of the book; serial, and storage for retrieval. In particular, the second of these principles will be examined.

An advantage of a systematic approach to course design is that definitions become sharper, and in particular features which belong to the medium can be separated from features belonging to the context in which the medium is used. It appears that books have not previously been stripped of their 'contextual features' and considered simply as devices. Decisions about the use of the device in any situation must derive from the context, that is, the objectives, the content, the learners, etc. An examination of the technical features of the device suggests a range of possibilities, and it is these that are explored in the following chapters.
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PART TWO

INFORMATION RETRIEVAL FROM TEXTBOOKS
CHAPTER THREE

INFORMATION AND THE INSTRUCTIONAL SYSTEM

1.1 Introduction
2.1 Print in Education
2.2 The Dual Function of the Textbook
3.1 Information as an Entity
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4.3 Retrieval Subsystems and the Learner
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CHAPTER THREE

INFORMATION AND THE INSTRUCTIONAL SYSTEM

1.1 Introduction

The first part of this thesis consisted of a general examination of the problems of instructional system development; the second part will concentrate on a much narrower subject in greater depth. This is the theoretical problem of the meaning of the term 'information' in an instructional context, and the related practical problems of the design of information subsystems, in particular textbooks. It will be argued that the design of textbooks as information stores can be based, to some extent, on an analysis of the information retrieval process, and consequently the theoretical problem is tackled first, in this chapter. The application of this is examined in Chapter Six; the two intervening chapters are analyses of related research.

Textbooks are only one possible type of retrieval subsystem; there may be large-scale libraries, and smaller collections of materials housed in learning resources centres, or instructional materials centres. There are two reasons for concentrating on textbooks. First, the area has hardly been investigated at all; and there seems to be an immediate practical problem to be tackled here. Secondly, the analysis of textbooks as stores of information provides a useful microcosm for large-scale retrieval problems. The possibility
of relating the analysis here to small collections of materials is touched on in the final chapter. Since there is already a very extensive literature devoted to the problem of retrieval at library level, this aspect has been left aside, but it is argued that the process of information retrieval is basically the same, on whatever scale it is conducted; it happens that retrieval on a small scale, within documents, has not been examined in relation to instruction.

One further note about terminology; from now on, the terms information system and retrieval system will be used instead of the longer information storage and retrieval system. This does not imply that retrieval can exist without storage, or that all information systems must be retrieval systems; information transfer takes place in the presentation and interactive modes described in section 4.3 of this chapter, as well as in the search, or retrieval, mode. The reduction here is simply for convenience. Information subsystems can be related to two larger systems; the general communication system, and the instructional system. Meadow has identified information retrieval as a subtype of the general communication system outlined by Shannon and Weaver, and Paisley and Parker describe it as a receiver-controlled communication system.

The description of information retrieval in the following chapters will make use of terms introduced in the section on general communication in the first chapter. The concern is still with communication in education, though now with a particular kind of communication: information retrieval.
It is felt that communication theory, despite its confusions and multiple approaches, and the shortcomings of the basic model used, provides the best available context for an examination of information retrieval.

In terms of the instructional system, an information retrieval system is a subsystem, or part of the larger system. Although the analysis here will concentrate almost entirely on problems within the subsystem, it is not suggested that this subsystem exists in isolation; it must be related to the broader design of the instructional system. In relation to these larger systems, information subsystems are relatively open-ended, or locally-controlled in that the instructional events that occur within them are not specified in any great detail by the systems designer. The main inputs are the task specification, the information in the system, and retrieval devices; training of the learners in its use may also affect the result. However, once given these inputs, the learner is free to use the system as he wishes. Relevant research on learner control is analysed in Chapter Five.

The following chapters are also related to Part One in that they are concerned with a mass medium, print. Although information systems are not confined to the use of any one medium, most of the work done on retrieval theory has been in relation to print. In education, textbooks provide a model for what might be the case with other media, like television and film, since they contain the problems associated not only with sequencing and presentation, but with storage and retrieval as well. After a short classification of print materials used
in education, this dual role of the textbook, as a sequence, and as a store, will be examined.

2.1 Print in Education

Print materials used in education can be divided into five categories. These are

1) Textbooks
2) Programmed texts
3) Shorter texts e.g. papers, study notes
4) General books
5) Ancillary materials, e.g. newspapers, magazines and handouts.

The difference between the first three and the others is that they are designed specifically for study, whereas the other materials are designed for general reading, and only incidentally for study. Although general books may be used a great deal in adult education especially if there are no specially written textbooks, they will not be examined here. Since they are created for a general audience, it is unrealistic to suggest that they should be designed according to specific study needs. However, one or two borderline cases of books which are aimed at both the student and the general reader have been included among the examples in chapter seven.

The difference between textbooks and short texts is simply one of length. Both are designed and used for study, but the crucial feature of the textbook is that it is large enough to make it worthwhile organising the information for
retrieval. A student faced with a six-page document can still scan the text itself with relative ease; faced with a forty-page document, scanning of the text becomes difficult. The cut-off point, if there is an exact one, at which scanning of the text becomes difficult and retrieval devices have to be introduced could be investigated experimentally. For the moment, only texts of substantial size, e.g. over 100 pages have been considered.

The main emphasis here will be on the textbook. An analysis of relevant research on textbooks is given in the next chapter. The reasons for concentrating on the textbook, rather than programmed texts, appear in the following quotation from A.A. Lumadaine's chapter on 'Instruments and Media of Instruction' in N.J. Gage's Handbook of Research on Teaching:

Despite the venerability of the textbook as a medium of instruction, a case may be made for the position that it actually has two quite distinct functions - that of a reference source of information and that of a sequenced medium of instruction or learning. The basic requirement for these two functions differ fundamentally, as, for instance, in the need for sequencing and redundancy of information. With the development of programmed self-instructional media and concomitant improvement in the information-retrieval utility of handbooks, and similar reference sources, it seems possible that the next decade or so may witness the decline, if not the demise, of the textbook, as now conceived, in favor of programmed instructional material on the one hand and of the well-designed reference handbook or source book on the other.
2.2 The Dual Function of the Textbook

In the above quotation, Lumadaine suggests that the textbook has at present two functions: it acts as a sequenced presentation of instruction, and also as a source of information, which can be used for reference. He argues that since these two functions are in some ways incompatible, the present textbook will split into two new forms of text; the programmed text, which is entirely devoted to sequenced presentation, and the handbook or source book which is designed solely for reference. He assumes that programmed texts are not usually designed to fulfill this dual function, for as Fressey notes, it is difficult to use them in any way except the straight 'work through'. So programmed texts do not normally pose this problem of reconciling information and instructional needs.

A description of these two functions may make the distinction clearer. If the learner is using the textbook as a 'sequenced medium of instruction', he begins at the beginning and works through the book in the sequence that the writer has devised, until he arrives at the end, or in the case of programmed texts, at the last frame. Niedermeyer has noted the importance of logical sequencing in programmed learning. Stated generally, the aim of the sequence is to take the learner from where he is already to where he is supposed to be by the end; that is, the text must bridge the gap between his entry behaviour and the criterion behaviour. Physically, this is a very simple operation for the learner;
he opens the book at the beginning, and keeps on turning to the next page until he reaches the end. The pages follow each other in the same way that the frames of a film do; they form a predetermined sequence. From the point of view of instructional design, it is thus important to create the best possible sequence; and this is a central planning problem, controlled by the course designer, or the source, in communications terms.

If the learner is using the textbook as a source of information he treats it as a store in which he searches out information which meets his needs. In this case, rather than working through the text simply from start to finish, he will formulate questions related to the subject, and then search in the book to find the part which has the information he needs. These questions can vary from precise factual ones to more general enquiries. In this search process, the learner is working out his own sequence, although it is clearer to call this, in information terms, a 'search pattern'. Physically, this is a slightly more complicated operation than the first one; instead of turning from one page to the next, the learner uses various 'retrieval devices' like the table of contents, the index, headings, to locate the information he wants, and then moves from those devices to the information itself. He will thus work backwards and forwards through the book as his needs dictate. Dictionaries and encyclopaedias are used in this fashion, and Lumsdaine refers to it as a 'reference' use.

Some books can be used in only one of these two ways. Programmed texts, and books with a dramatic sequence, are normally
used only in the first 'linear' manner. Reference books —
dictionaries, directories, bibliographies, encyclopaedias,
etc. — can only be used as stores of information, since
there is no meaningful sequence in them. A large number
of books, however, can be used in both ways, and as Lums-
daine points out, textbooks are usually designed for both
uses. It is useful to think of the book as a physical
device which is capable of being used in two different ways,
or in combinations of these ways. Although the distinction
between these two ways of using a textbook is emphasised in
this chapter, it may be that the best strategy for learners
to adopt is a combination of searching and serial reading.
Compared with some other devices, like off-air radio, the
book is more flexible in that it allows the user to manip¬
ulate the linear sequence according to his own needs.

So far, Lumsdaine's distinction seems clear. There is
however a difficulty which stems from his use of the word
'information'. In the first part of the quotation, a
distinction is drawn between 'information' on the one hand
and 'instruction or learning' on the other. Earlier in the
chapter, he defines instruction as follows:

Instruction is used as a generic term referring to
any specifiable means of controlling or manipulating
a sequence of events to produce modifications of
behavior through learning. It is applicable whenever
the outcomes of learning can be specified in suffi-
ciently explicit terms to permit their measurement.
These outcomes may include changes in attitudes,
interests, motivations, beliefs, or opinions as well
as in knowledges, skills, and other performance
capabilities, so long as they are defined in terms
which identify specific, observable behaviors agreed
to be manifestations or indications of these outcomes.
Lumadaine's emphasis on specifying behavioural outcomes here may obscure what is more important in this context: his definition in terms of control or manipulation, and of sequencing. Instruction, in his view, involves control. This control is exerted through a sequence of events. There is nothing problematic about Lumadaine's definition; what is difficult is his opposition of 'information' to 'instruction or learning' in the first quotation. From the second quotation it can be assumed that his definition of learning would be in terms of the processes whereby observable changes in attitudes, motivations, knowledges, skills, etc. take place. Instruction can produce these changes, but Lumadaine seems to be implying that information either cannot, or is not in the same category at all. This problem can be clarified by the examination of two ways of conceptualizing information: as an entity, and as a process.

3.1 Information as an entity

Meadow has pointed out that neither he, nor anyone else, has been able to define information; he calls it an 'abstraction' and writes 'Although information can be measured in an engineering sense, and its problems and functions defined, we are still unable to describe it well analytically'. Despite, or because of this difficulty, the word has strong connotations, and one of these appears in a recent article on curriculum reform:
What is information orientation and why are curricula so oriented? Information orientation quite simply refers to subject matter content dealing with topics which are presented in such a way that learning becomes primarily a memorization process. Learners acquire bits of information, such as names of authors, painters, composers and inventors; assorted dates associated with discoveries, financial transactions, court rulings and battles; the names of the parts of animals, plants, machinery, grammar and speech; and thousands of other assorted facts.

Here information is taken to connote facts of the kind mentioned in the passage; and the criticism is not that this is the wrong kind of information, but simply that there is too much of it, and it is too discontinuous. In a better-designed curriculum, the authors suggest, the amount of information would be decreased, and information would provide the basis for problem-solving exercises:

Information would not be excluded from the new curriculum, but the amount would be reduced. Whereas information is now both the means and the end of instruction, it would in most instances be reduced to the role of means only. Information would provide the basic input—the grist—for the development of problem-solving skills.

Although the role of information has been altered here, the concept is the same: information is an entity; it is factual, discrete; it provides the grist for other mental activities.

This view of information as facts is apposite in certain contexts. This is the kind of information associated with trains, tourism, spying and government information bureaux. In other contexts, however, information signifies something broader: an information officer in industry or commerce supplies whatever kinds of information his clients want or he thinks they
need, and this is not confined to simple facts and figures. ERIC (Educational Resources Information Centers) in the U.S.A. disseminates a wide variety of types of information, mainly in the form of articles and reports. The question here is not which of these should be transferred to the educational context, but whether any of them should be. For if information is an abstraction, then its definition will depend on the particular context of its use. In education, this in turn will depend on the overall design of the information subsystem.

Lumsdaine, by limiting information to 'reference' information, implies that he views it in much the same light as Burns and Brooks above: facts, unrelated and isolated, such as are found in the reference section of a library. If so, then the function of information in the curriculum is likely to be what Burns and Brooks advocate: grist to the mental mill. It is not surprising that Lumsdaine refers to it as a 'utility'.

The contradiction which Lumsdaine sees in the dual function of the textbook stems from his emphasis on information as an entity. The sequenced presentation has either too much or too little redundancy — it is not clear which — to make it a useful source book as well. Lumsdaine suggests that there is an inherent contradiction between the two types of information needed in the book. Yet in the description given above of the second use of the textbook, as a store of information, no reference was made to the type of information stored. The description was of a process of retrieval, which made use of
retrieval devices such as the index and table of contents. The difficulty of using programmed texts as stores lies not in the content, but in the fact that they may not be indexed, provided with headings or introductions. This suggests that instead of conceptualizing information as an entity, it might be more helpful to look at the process of information retrieval. This does not mean that the word 'information' cannot be used to denote an entity or commodity — the content of the system — but rather that discussions of information must take into account the other elements in the system; the organisers, users and retrieval devices.

3.2 The Process of Information Retrieval

Although Meadow, as noted above, could find no satisfactory definition of information, he can give a description of the process of information retrieval. He views this as a particular type of the general communication process described by Shannon. The process and elements of a retrieval system have been described by Vickery as follows:

Essentially, therefore, retrieval is concerned with the structure and operation of devices to select documentary information from a store in response to search questions. A store is a collection of documentary information: I have given as an example a library, but an abstracts journal or even a single textbook is in this sense a store, so that an index to such a journal or book can be called a retrieval device.

Vickery identifies three main elements: a store of information, retrieval devices and search questions. He explicitly mentions a textbook as an example of an information store;
this is unusual because retrieval theorists are normally concerned with retrieval of documents rather than retrieval within documents.

Vickery's description can be expanded. The store consists of an number of units of information. These may be stored on various media — print, film, tape, etc. — but have traditionally been in print in the form of books. The unit is the unit of production; that is, the author and publisher decide what constitutes a particular book. However, the librarian, or whoever is organising the system may decide to modify these production units by breaking down the book into chapters which are stored separately, or collating sections from different documents and storing them as one. The information store is usually a physical location such as a library, but it is becoming possible to 'move' information from various locations to various access points. This is done by means of electronic transmission, with dial-access retrieval systems. Consequently, the physical location of the information becomes less important, and the points of access more important. It has been pointed out that whereas the mass media tend to move information to people, in their homes, people have to move themselves to get at educational information, stored in central libraries and schools. It is also worth noting that although the storage and preservation of information was extremely important in the past, due to the scarcity of stored information, it is much less important nowadays than the problems
of dissemination created by the information explosion —
the sudden increase in the amount of information being
produced. In general, the nature and importance of the
store in the retrieval system are undergoing changes.

The second main element in Vickery's description, the
retrieval devices, perform two basic functions although
they do these in a variety of ways. These are the reduction
and the organization of the stored information. Reduction
is achieved by substituting descriptors, a word or a number
of words, in place of the original information. The giving
of a title to a book or a film is an example of this. It is
important, however, to note that reduction is not a straight-
forward exercise; this point is developed in Chapter Six.

The other function of retrieval devices is to organise
the descriptors that have been arrived at. This is done by
using various forms of classification, or subject analysis,
which allows the descriptors to be arranged in a meaningful
order. When the user becomes familiar with this order, he
can decide which parts of it he has to inspect, or scan, and
which parts are irrelevant. Attached to each descriptor is
the address of the unit of information, which tells him where
it is stored. All the descriptors and their addresses are
stored together in a file.

The third element in the system is the search question,
or query. This can vary from specific requests for particular
documents, or the answers to factual questions, to general
requests for 'something-up-to-date on programmed learning'
or 'an introduction to Indian music'. Three factors in particular influence query formulation: the user’s own pattern of concept association; his objectives, and his expectations about the system. This last factor is important in that it can lead to a modification of the original query: a process which is called query control. In attempting to match his query with the descriptors in the system, the user may find that he has to tailor his query, or rather the language of his query, to fit the descriptors used in the system. The more rigid the system, the more control is exercised:

As psychologists have long been aware, there is great diversity (and apparent irrationality) in patterns of concept association. Many present systems offer the receiver the choice of suppressing his own associative habits in order to learn arbitrary programmed into the system, or of simply failing to obtain the information he seeks — two unsatisfying solutions.

This delicate process of matching, is the main problem in subject analysis, for the analysis of the information must take into account as many patterns of concept association as possible.

One further point needs to be made about this process; it can be a repetitive and developmental one. A query may turn up information which then modifies the original query rather than simply answering it. Information retrieval, when it is not a single search for a single piece of information, can be viewed as a continuing interaction between the user, the system and the information in the system.

There are other problems in the operation of retrieval systems which have not been mentioned here. In particular, there is the problem of the 'referent': the relationship between the
the information in the system, the user and the 'real world'. Neither have different forms of indexing been discussed here. These problems, however, might obscure the point of this description, which is that it is possible to describe the process of information retrieval without describing the information itself. This suggests that it may be more useful to examine the process of information retrieval in education than to consider information as an entity, in particular as reference or factual information. The question then arises: is the process of information retrieval related to or distinguishable from the processes of instruction?

4.1 Information and Instruction

The relationship between the processes of information retrieval and instruction turns on the question of control. It was noted above that Meadow defined retrieval systems as subtypes of the general communication system. Paisley and Parker make a similar point, and state that receiver-control is the characteristic feature of retrieval systems. Thus we have characterized information storage and retrieval systems as receiver-controlled systems for the communication of information through space and time. Obviously, any communication system can send only those messages that the source puts into the system, and to some extent it must be source-controlled. But information retrieval is distinguishable from most other sorts of communications (e.g., persuasive communication such as television advertising) in the amount of receiver control it permits.
They explain this distinction between source- and receiver-control further:

In a source-controlled communication system, the choice of message content and form, the choice of audience, and the choice of time and method of transmission are all prerogatives of the source. Given a Skinnerian (operant conditioning) orientation to the communication process, we may assume that the source chooses a combination of these variables that will maximize positive reinforcement as a result of communicating.

Paisley and Parker are using general, and not specifically educational terms. Translated into an educational context, the source will choose the combination of variables that will maximize learning for a particular student, taking as many variables as possible into account. The model of computer-based instruction given by Unwin is a sophisticated example of source control.

In a receiver-controlled system, the user controls a variety of factors, though not the precise content.

In its pure form a receiver-controlled communication system is an anomaly. To control message content, the receiver has to be familiar with the universe of messages from which selection occurs. The greater his control, the greater his familiarity with the universe of messages, the less he can learn from the source. By "receiver-controlled communication system" we therefore denote a system in which the receiver may choose a source, message form, and time and method of transmission — but not precisely the content of the message itself. We may similarly assume that the receiver chooses a source, time, method, and form that will maximize his expected profit in receiving the communication.

Translated into educational terms, receiver control of this kind means that the learner could choose his teacher, medium, time and mode of presentation of the lesson. This degree of choice is unlikely to exist, since the resources to allow it
are usually not available. What is possible and relevant to a discussion of receiver-control in education is control over pacing, sequencing and possibly medium. A learner might be able to choose to receive instruction in a particular sequence, at a particular speed, and either in book or videotape form.

Paisley and Parker conclude by relating their ideas to different stages of education:

We consider the analogy between information retrieval and education to be strongest at the end of the educational continuum at which the largest measure of receiver-control is exercised — i.e. the upper end. It is part of our education tradition to mean a child from dependence on source-controlled communication and to expect of him ever greater self-responsibility in his choice of communication sources, forms and methods. Freedom from source control is perhaps never complete, but the expected relationship between communication control and education level is roughly as follows:

<table>
<thead>
<tr>
<th>Independent Scholarship</th>
<th>College</th>
<th>High School</th>
<th>Grade School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source Control</td>
<td>Receiver Control</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

It is worth distinguishing here between different types of arguments for having retrieval systems in education. One argument is that they may improve learning, as shown in the outcomes of a particular course; this is a short-term objective. A middle-term objective might be to develop study skills in finding and organising information which can be usefully transferred to other areas of study. A long-term objective, of the type that Paisley and Parker
cited above, could be to develop self-reliance in the handling of information in life generally i.e. to know where to look for information, and to be able to discriminate relevant from irrelevant information. For the moment, this discussion will deal only with the first objective, to improve learning in the short term. This objective will be related to adult learning in the chapter on learner control.

Paisley and Parker have described a retrieval system as one where the user, or learner has control over certain factors in communication. They contrast this with source-controlled systems, where almost all control is vested in the source, or in instruction, the course designer, programmer or teacher. This formulation can be looked at from two angles, that of the system designer and that of the learner.

4.2. Retrieval Subsystems and Instructional Systems

From the point of view of the overall design of instructional systems, the creation of retrieval subsystems controlled by the learner, represents a devolution of control. This is within strict limits: the learner is allowed control only over sequencing, pacing, and possibly the range of content. Nevertheless, it means that within this particular subsystem, the designer cannot specify instructional events in detail. He leaves the learner free to operate within a certain limited environment and he cannot be sure that the learner will choose the best search pattern for himself, or the best pace at which
to work. However, he can ensure that the learner is well equipped for the task, as regards his understanding of the final objectives, the system he is using, and to some extent his own patterns of concept association. The creation of such a learner-controlled subsystem has considerable significance for systems theory. The implication is that the system designer is not always the best person to exercise detailed control over the instructional process. This is better understood as a devolution of control than as a creation of 'open-ended' learning situations. The term 'open-ended' is negative in that it merely states that the designer is not controlling the subsystem; the point here is that control is still being exercised, though the locus of control has shifted. Hypothetically, one can imagine four different subsystems within an instructional system, which are controlled respectively by the system designer, a teacher, a television producer, and a learner. The first might be a programmed section of the course, either computer-based or in text form, in which the responses of the learner determine which of a small number of predetermined paths he shall follow. In the second case, a teacher may be given control over a discussion group for a number of periods, to work is a fairly flexible relation to programmed sections of the course. In the third case, the television producer may be given a brief to make a programme covering certain points in a certain way, and allowed to make all production decisions. The last case might be a learner-controlled information system.
Although the last three of these cases are open-ended in that the system designer has not determined all the inputs, they are not vacuums in terms of control. In each case, control is being exercised by someone; in the last case, the learner. The adoption of this kind of system model, which contains hierarchies of control, rather than direct central control, opens up the possibility that individualization can take place under centres of control which are close to the individual learner, and even under the control of the learner himself. This is rather different from the notion of centrally-programmed individualization suggested by Unwin's diagram. Subsystems are not simply parts of the total system, but miniature systems in their own right. In the case of a learner-controlled subsystem, the learner must also go through the basic stages of system analysis for himself, although the process may be an extremely subjective one. Nevertheless, he will take into account objectives, as he perceives them at each stage, considering alternative strategies, and make use of feedback. In such a 'devolved' system model, the task of the system designer becomes differentiated; apart from the overall system specification, he is involved in the detailed design of some subsystems, but not others; and an important task is to harmonise the relationship between centrally and locally controlled subsystems.

4.3 Retrieval Systems and the Learner

From the learner's point of view, it matters little if the message he receives is controlled by the system designer, the
various writers employed or the contact teacher; they are all source-controlled messages. The learner can find himself in one of three types of communication situation.

The first can be called the presentation mode. This is the type described by Paisley and Parker as source-controlled. The degree and range of control can vary. It is at its greatest in computer-based programmes of the type described by Unwin, in which all decisions except the decision how to respond are taken by the machine. There can also be strict control in programmed texts:

We are trying to control what he looks at by using small frames, and what he looks for by requiring him to make a response. Thus if we wish to make him remember something, we must call for a response which he can supply correctly without looking at something which will give the answer away.

Other factors can be controlled by the source. A student listening to a lecture has to follow the lecturer's pace, sequence, and unless he asks questions, scope of content. With most mediated instruction, the learner cannot ask questions, but he may be able to stop and repeat parts of the instruction, thus gaining some control over presentation. If it is a broadcast programme, the learner has no choice but to follow the programme as it has been designed. The most typical examples of presentation mode are programmed texts, lectures, broadcast lessons and films. These have in common a high degree of source control over the source of content, range of content, sequencing of content, pacing of content, choice of medium and schedules of response.
A second communication situation is the interactive mode in which the learner has some control, but shares it with other people. The most obvious examples of this are group discussions, seminars and tutorials, and to a lesser extent the ordinary class. In a group discussion, for example, the learner can influence the range and depth of the discussion, and the order in which topics are discussed, but he shares this influence with a number of others, including sometimes a discussion leader. In a typical class, the teacher still controls the overall scope and sequence of the lesson, but depending on how flexible he is and how forceful the students are, anyone of them can alter the course of the lesson to some degree by asking questions, or making contributions.

The third communications situation is the search mode, and it is this mode the learner is in when he is operating a retrieval system. He has at his disposal a store of information, and freedom to determine his own pace, his own sequence, and within limits the sources of his information. He can choose between one book and another, or one chapter and another, and he can read on or retrace his steps as he pleases. It is possible, but rare, to find another person, such as a teacher, acting as a store of information in this way, and responding to the learner’s questions without actively guiding him. There has, however, been one experiment on this conducted by Mager which is reported in Chapter Five.
The use of people as information resources is too costly to be widely practicable. However, some new forms of mediated instruction, like EVR and videotape, which have stop-frame and rewind facilities, could form useful information stores if adequate retrieval devices are provided. The learner would then be able to search through a complete multi-media store of information, rather than just a single book, or set of books.

These three communication modes are not absolutely distinct, and each has some elements of the others. They can best be seen as a continuum ranging from high source control in the presentation mode, through joint control in the interactive mode to high receiver control in the search mode. It is now time to clarify the dual function of the textbook in the light of this.

5. Conclusion

The first function of the textbook noted by Lumsdaine was as a 'reference source of information'. The limiting connotations of 'reference' here have already been discussed. The learner using a book in this way is in the search mode, exercising a high degree of control himself over sequencing, and using the retrieval devices provided to move around in the material. The second function, a 'sequenced medium of instruction' refers to the presentation mode: the learner is following the sequence determined by the source, responding to the stimuli presented to him in the order and amounts planned. It appears from this that Lumsdaine is equating
instruction with the presentation mode, which is a limiting position, for it takes no account of the control or manipulation of variables in the learning situation by the learner himself. Furthermore, by linking learning with instruction and not with information, Lumsdaine implies that learning does not take place in the retrieval process, or search mode.

The confusion here seems to trace back to the misleading view of information as an entity, rather than a process. As this is the main theoretical point in the present work, it can be reiterated. Information is an abstraction from systems of information retrieval. The connotation of facts is incidental; there is no limit to the type or scope of information retrieved other than what is contained in a particular system. Viewed as a process, information retrieval is related to other instructional processes by being concerned with the communication of messages, and distinguished from them by its high degree of receiver control and the existence of retrieval devices. Within the total instructional system, it constitutes a locally controlled subsystem, in which the instructional events have not been specified in detail by the system designer. These, then are the two theoretical points which arise from this analysis: first that the term 'information' as used by Lumsdaine in an instructional context, is best understood as a process, not an entity. Secondly, in the context of the total instructional system, it constitutes a devolution of control to the learner within certain limits. This suggests a view of systems design which
sees it concerned not so much with the detailed specification of instructional events in all parts of the system, as with the integrating of centrally controlled and locally controlled elements within the whole. The second of these may be controlled by the learner or learners, contact teachers, or writers and producers of mediated instruction.

It is now time to look at the practical implications of this redefinition of information for the design of text materials. This will be investigated in chapter six. The next two chapters will provide analyses of relevant research in two areas: learner control of sequencing and textbooks in education. These give guidance on the practical problems of designing textbooks as information stores.
REFERENCES TO CHAPTER THREE


8. See reference 3.


11. ibid.


26. *ibid.*


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33. See reference 3.

34. See reference 3.
CHAPTER FOUR

TEXTBOOKS: AN ANALYSIS OF RELEVANT RESEARCH

1. Introduction

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CHAPTER FOUR

TEXTBOOKS: AN ANALYSIS OF RELEVANT RESEARCH

1. Introduction

The discussion in the last chapter arose from Lumsdaine's distinction between the two functions of textbooks as sources of information and sequenced media of instruction or learning. In this chapter, research on textbooks is analysed as a first step towards rationalising the design of textbooks as information stores. This will be restricted to research into format, retrieval and organizational devices in the text, and the uses readers make of these. Since Lumsdaine's point was made with regard to textbooks, rather than programmed texts, and as there seems to be no relevant research on retrieval devices in programmed texts, they will not be considered.

2.1 Main Sources

There are reviews of textbook research by Otto and Flournoy (1956), Hockett (1959), Buckingham (1960), Davis (1962) and Hilton (1969). There is also an extensive review of research into reading by Harris (1969) which covers factors of text design and format. The other main sources are Cronbach (1955), Lumsdaine (1963), Brown, Lewis and Harcleroad (1968), Smith and Smith (1969) and Dale (1969).
Cronbach's book, *Text Materials in Modern Education*, published in 1955, is still the major work in the field. Horn's work appears to be a new departure.

2.2 The Role of the Textbook

Most of these writers mention the ubiquity of the textbook. Cronbach begins his study with these words: 'At the centre of present-day educational scene in America is the textbook.' This was in 1955; and Hilton, writing in 1969, notes the continuing centrality of the textbook in American education. This is despite Lumsdaine's and Glaser's predictions of its decline in favour of more programmed materials. Jensen is of the opinion that textbooks have never had as central a place in adult education as they have in the school system:

In adult education the textbook has never achieved the predominant part it plays in formal education. A great deal of information in adult education comes from other human beings; when such information is in the form of lectures, the word 'instructor' is most often used; otherwise the concept of 'resource person' is often introduced. He is someone who serves as a source of information but not a final authority.

Jensen, transposing the functions of the book into human terms, makes almost the same distinction between 'instruction' and 'resource' of information as Lumsdaine. This suggests that it might be useful to examine the role of tutors or teachers as human information stores, and the matching process in human information transfer. At least if the textbook itself is not ubiquitous, the functions it performs
seem to be so, whether they are performed by media (here, print) or by people, or a combination of both. An experiment conducted by Mager which investigated the use of teachers as a non-directive resource is reported in Chapter Five.

2.3 The Definition of a textbook

The problem of defining a textbook was touched on at the beginning of the last chapter. Buckingham considers that the textbook is 'so broad as to defy brief definition.' Cronbach, writing before programmed texts became common, arrived at the following definition of a traditional textbook:

The textbook is a textbook by virtue of the principals which control its selective organization of subject matter. (1) The Materials must hang together in some way, and coherence is usually achieved in terms of an organized discipline. (Thus a text is a text in grammar, geology, geography, or some other "subject"). (2) Not all the information which exists in any one discipline can be presented in the text. Therefore, the writer seeks to incorporate the essentials; that is, to define basic concepts, statements, principles, and to explain and illustrate their application. (3) The text is usually written for immature learners. Therefore, the discipline must be simplified to whatever degree fits the intended learner. It is understood that texts written for more advanced learners will later present the same discipline with more precision. (4) Typically, the text is organized as a course of study, so that chapters are to be studied in sequence. Later chapters presuppose an acquaintance with earlier chapters.

These criteria have to do with content, rather than format and organization. Only the last bears on the question of organization; the text is typically divided into chapters.

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which have to be studied in sequence, since there is a progression in the content. This description of organization — a sequence which is divided into parts or sections — could equally well apply to a programmed text. The parts, or frames, of a programmed text, may typically be shorter than the chapters of a textbook, but small frames are by no means an essential feature of the programmed text. The typical programme will allow the learner to respond, usually to questions, periodically, and provide him with a knowledge of correct results afterwards; on the other hand, some textbooks incorporate questions and answers in the text, and it may become increasingly difficult to draw a distinction between the two in this respect also. Since many of the features of early programmes, like short steps, overt responses, easy progression from one step to the next have been shown to be inessential in some circumstances, the definition of programming has tended recently to concentrate more on the procedures for producing materials, and much less on the actual form of the materials, which will vary from one situation to another.22 The only variable which still seems to be considered essential is the notion of sequence.23

This recalls Lumsdaine's original distinction, because it is precisely the sequence of stimuli which is not predetermined in a retrieval system; the learner can dictate his own sequence, using retrieval devices to select materials
in the order he wants. It is thus the existence of retrieval devices like the index and table of contents which distinguish a textbook from a programme. Both have an ordered, logical sequence, and both can be used in this sequential fashion; but only the textbook can be used as a learner-controlled source of information. The availability of retrieval devices in the textbook does not automatically mean that they will be used; in fact, there is some research which suggests that students have to be taught how to use them.

3.1 Research on Textbooks - a general view

The difficulties of defining a textbook may be one reason why research on them is relatively sparse. This lack of firm findings has been noted by Cronbach.

The sheer absence of trustworthy fact regarding the text-in-use is amazing. There is dissatisfaction with texts as with other aspects of education, but among the possible points of improvement there is inadequate evidence to tell where the greatest proportionate need lies. Thus the literature seems to reflect empty controversy, with every participant certain that his responsibilities regarding the text are far better executed than those of his opposite numbers.

Hilton, writing recently, again comments on the lack of research. This could be due also to the difficulty of designing research in this area. Lumadaine argues that textbooks do not provide sufficient control of the learning situation to make experiments possible:
The usual textbook does not control the behavior of the learner in a way which makes it highly predictable as a vehicle of instruction or amenable to experimental research. It does not in itself generate a describable and predictable process of learner behavior, and this may be the reason why there has been very little experimental research on the textbook.

Two points can be made about this argument. First, a distinction can be drawn between research on textbooks as a whole, and research on various features of textbooks. It may be that textbooks, taken as an unanalysed whole, contain too many variables to be amenable to experimental research. This does not preclude isolating and testing various features of textbooks, and as Hilton notes, this has been done in some depth with content analysis, readability and typographic features. In order to pursue such a research strategy, an adequate description of the features has first to be made.

The main descriptive division in this thesis has been made between sequential and storage aspects, and within the storage aspect, devices and features such as headings and indexes have been identified. The outlines for further research in the final chapter propose isolating these devices one by one, and testing their effectiveness under various conditions. In this way, information can be had about isolated features of the textbook, and about combinations of such features.

The second point has to do with Lumsdaine's argument about control. He is correct in pointing out that the textbook does not control the behaviour of the learner in a predictable way. The provision of retrieval devices leaves
the learner free to devise his own search patterns. But it is not necessarily correct to argue from this that the textbook cannot become a 'highly predictable vehicle of instruction', since the controlling factors can come from other elements in the situation, in particular the task specification and the learner. In this respect, the user-textbook interaction can be regarded as an indeterminate area which nevertheless has specified inputs: the learner's capacity for self-organization, the task specification, and the textbook. If these inputs can be manipulated so as to consistently produce a desired result, then the textbook is a predictable instructional device, even though the exact process of interaction cannot be described. In addition, research into specific aspects of the textbook, as described above, may increase the effectiveness of the textbook.

3.2 Research on Textbooks as Information Stores

It should first be established that textbooks can be regarded as information stores. This has been argued by both information theorists and educationists. Vickery's example of a textbook as an information store has already been quoted; Heilprin and Goodman make a similar point:

A lecturer or textbook author strives to substitute surveys, outlines, digests, examples and analogies for the "original" material. A switching system (a system which organizes pedagogical material) is used to permit the student to divide the total collection of material to be learned into a part to be sensed at a particular time and a part to be eliminated for the time being.
Barnes, writing primarily about textbooks rather than about information retrieval, comments on what he describes as the 'reference view' of textbooks:

The textbook, according to this school of thought, is simply a cyclopaedic book containing authoritative information in certain branches of knowledge. It is identical with any other book of a factual or specialized nature suitable for pupils of varying abilities. It should be used as a library reference to help fulfill some purpose of the learner. Like other library references, it should be used selectively to aid in some learning project which has grown from sources outside the book itself.

Barnes is mainly concerned with the relationship between the teacher and the textbook, but the important point he makes here is that the textbook can be used selectively. The particular connotations of 'factual' and 'cyclopaedic' are incidental; it is the retrieval devices which permit selectivity. Thus, from the viewpoints of both retrieval theory and education, there is some agreement that textbooks can be seen as stores of information, to be used selectively. The scope of this use may be considered very limited; the implications of the word 'reference' are that this is mainly a factual use; the word 'review' suggests that the use is mainly retrospective, after the book has been read serially.

Only two experiments have come to light, despite an extensive search through educational and psychological journals, which attempt to investigate the effects of individual retrieval devices in texts of learning. They are Robinson and Hall (1941) and Christensen and Stordahl.
(1955)\textsuperscript{33}, both reported in the *Journal of Educational Psychology*. Harris\textsuperscript{34}, in a recent review of research, reports no relevant research after the second. Two points can be made about this research.

The first is that in neither experiment are the objects of investigation described as 'retrieval devices'. Robinson and Hall refer to 'reading aids'\textsuperscript{35} and in the second experiment they are called 'organizational aids'\textsuperscript{36}. This implies that the rationale for investigation developed in this thesis, in terms of information retrieval and learner control, was not used. The researchers therefore lacked the terms and concepts which might have clarified the process they were investigating.

### 5.3 Organisers and Descriptors

These differences in terminology become important if — and this is the second point — the meaning of 'organisation' as used above by Christensen and Stordahl is considered. Ausubel\textsuperscript{37} has researched into the effect of organisers in study material. Christensen and Stordahl\textsuperscript{38} reviewing previous research into the organisation of written material, consider the following devices: headings, summaries, and questions in the text. Their own research is into the effects of outlines, summaries, underlining and headings. It will be argued that some of these devices organise the material rather than facilitate retrieval from it, and *vice versa*. 
The distinction between organisers and descriptors is not absolute, but there can be a considerable practical difference. In the account of the basic process of retrieval given in the third chapter, it was said that the process involved both the reduction of the original material to descriptors, and the organisation of these descriptors both to relate and isolate them. The point of doing this is that it allows the user to scan much less material than he would have to do if he were faced with the total information store. Using the set of descriptors, which is organised to show relationships between them, he can scan a very much reduced version of the original in a much shorter time, or manipulate the original sequence in the way that suits him. This is not however the same as scanning a summary, for the summary is a reduction of the whole as a whole, whereas each descriptor in an index file refers to a part of the whole. The user can move from any one descriptor to its unit, but he cannot move from any one part of a summary to the relevant part of the text unless some system of notation allows him to. Thus a summary is not a retrieval device unless it is supplemented by other devices, like a table of contents or section numbering or headings. A retrieval system is therefore a reduced version of the original text which is related to specific sections of the original. The descriptors used in the system inevitably 'organise' the material in a minimal sense; since a reduction of the original information is involved, the
descriptor must select some features of the original and omit others. In this sense, then, it provides an orientation on the original. But it is an orientation inversely proportionate to the ratio of the number of descriptors to the text; a set of a hundred descriptors, used evenly over the whole text will be less selective than a set of ten. Thus the argument that retrieval devices organise the material is truer of the table of contents than of the index, because the index is that much nearer the text itself in number of descriptors used.

Organisers, in the sense used by Ausubel, have a different function. Whereas the descriptor increases receiver-control of sequencing, the organiser attempts to increase source control, by directing the reader's attention towards certain items of information. They are usually, though not always, at a higher level of generality than the text itself:

These advance organisers consist of introductory material at a higher level of abstraction, generality, and inclusiveness than the learning task itself. The function of the organiser is to provide ideational scaffolding for the stable incorporation and retention of the more detailed and differentiated material that follows in the learning passage, as well as to increase discriminability between the latter and related, interfering concepts in cognitive structure.

The function of the organiser, as described by Ausubel here, is not to reduce the material for purposes of selection and manipulation, but to prepare the reader to receive certain information. The rationale is based on a psychological assumption:
...new ideas and information can be efficiently learned and retained only to the extent that more inclusive and appropriately relevant concepts are already available in the cognitive structure to serve a subsuming role or to furnish ideational anchorage. But even though this principle seems rather self-evident it is rarely followed in actual teaching procedures or in the organization of most textbooks. The more typical practice is to separate topically homogeneous materials into separate chapters, and to present them throughout at a uniform level of conceptualization, in accordance with a logical outline of the subject matter organization.

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Ausubel is arguing that subsuming concepts must be introduced at the beginning in order to give the reader a grasp of the outline of the material, into which he can then fit more detailed information. The rationale behind a retrieval system is different; apart from the possible saving in time, the argument is based on the hypothesis that some learners, in some situations, will learn better through being able to manipulate the material, and thus the information input, than if they have to follow a sequence devised by someone else.

The result of making this distinction, which it must be repeated is not an absolute one, is that only some of the "organisational aids" listed by Christensen and Stordahl can be regarded as retrieval aids. Retrieval aids, it has been argued, must be linked by notation or position to specific units within the text. Thus headings in the text qualify, since they allow quick scanning and are linked to the information they describe by their proximity to it.
Summaries are not retrieval devices unless linked to the text by a notation system of pages or sections. The same applies to outlines. Questions in the text are organizational rather than retrieval devices since although they are physically near the information they bear on, locating and scanning them is difficult. Headings in the form of questions are retrieval devices since they can be scanned more quickly than the text itself. Underlining is again an organizational rather than a retrieval device since it involves scanning the text itself.

These criteria mean that research on organizational rather than retrieval devices is not relevant, and this excludes work by McClusky, Holmes and Washburne. It is now time to look at the two experiments referred to at the beginning of section 3.3.

3.4 Research on Textbooks as Information Stores (continued)

Robinson and Hall's experiment is reported along with a series of experiments on reading rate. Their hypothesis, derived from manuals on reading and study, was that headings in the text would increase reading efficiency, since they indicated the ideas to be developed. This is an organizational rather than a retrieval rationale, but does not preclude the second, since headings can be used either way, and there is nothing to suggest that they were not used for scanning and switching. Two passages on Russian and Canadian history, between 3,000 and 4,500 words long, were given to two groups of college students. Each group had headings in one of the
passages, a different one in each case. Both groups were tested for reading rate (words in nine minutes) and comprehension. The reading rate test implies that the texts were read in a linear fashion, but does not preclude short movements back or forwards within the linear procession. The results showed no significant difference between the two versions. The authors conclude:

...this last study indicates that few college students (representative of superior readers in the total population) have learned the higher-level technique of using headings as a means of reading textbook material effectively. Obviously, such a lack of study skill indicates a definite instructional need of students.

The authors believe that the existence of this device is not enough: students must be trained to use it.

Christensen and Stordahl report an experiment with two passages of approximately 2600 and 3800 words. The subjects were U.S. Air Force basic trainees, and there was both immediate and delayed comprehension testing, consisting of about forty multiple-choice items. The passages differed in the presence or absence of one or a number or all of the following:

1) An outline at the beginning of the passage
2) A summary at the beginning of the passage
3) A summary at the end of the passage
4) Underlining of main points
5) Headings in statement form
6) Headings in question form
Of the above devices, only the headings can be identified certainly as retrieval devices. The actual form of the heading, whether statement or question, is irrelevant, since it is the positioning of the heading as a descriptor which is important, not its content. The underlining of main points is an organizational rather than a retrieval device, designed to emphasise information as it is read. They may have a marginal use in orientation if the text is being scanned quickly. Neither the summaries nor the outline can be counted as retrieval devices, since they are not related to units within the text by any notation. In texts as short as this, it is possible that the reader could work from a part of the summary to the related part of the text simply by scanning the text, but there is nothing to encourage him to do so; and the authors do not report any such use. The overall rationale for the experiment appears to have been an organizational rather than a retrieval one.

The authors found that there were no significant differences in comprehension for any of the thirty-six versions presented. In their discussion, they suggest that the results might be different with a different population, different materials, or with students trained to use the devices. Harris, commenting on these results, writes: 'That finding, strongly suggests that the critical organizational factors in reading and study lie in the mind of the reader', and more generally 'the relative merits of several common aids
to reading and study in content fields do not appear to have been clearly established. He does not report any more recent research on the subject.

Three comments can be made on these experiments. First, the passages used may have been too short to necessitate the use of devices for retrieval; no passage was longer than 4500 words. A reader may be able to manipulate a passage of this length simply by scanning the text. Secondly the only retrieval devices to be tested were headings and underlining. No other retrieval devices were tested, and the description of the experiments in terms of 'organisers' has already been noted. Thirdly, neither were the subjects instructed in the use of the devices. Robinson and Hall suggest above that there is an instructional need, and ascribe the lack of difference in results to this rather than intrinsic ineffectiveness in the devices.

A report of research by Horn and others on new ways of organising and presenting text material has recently become available. Some examples from his book are given in Chapter Seven. Horn describes his new methods of structuring material as 'information mapping', and suggests that it is useful for 'learning and reference'. He argues that information mapping helps the learner to organize and integrate the material, and refers to studies by Ausubel, Stafford and Combs, and Katena which he suggests provide support for organizational features in information maps. He also refers to educational research on feedback, introductions and reviews, underlining and the use of pictorial material. The main
features of information mapping as they appear both in Horn's book, which is written partly in this form, and from his description, are as follows:

1) Organization of the text. The text is divided into blocks of information, with standardized format for different types of information, e.g. concepts, procedures, compare-and-contrast material. Each map, which is usually on a single page, consists of several of these blocks.

2) Headings and Titles. Each map is given a title, and there are headings in the margin for each block of information.

3) Considerable use is made of previews, reviews, summaries and other overview material.

4) There are questions after maps to provide feedback to the learner, and self-tests at intervals.

5) Some use is made of diagrams, charts and trees of the material.

6) There are local indexes, at the foot of each page, showing related and prerequisite material, and also alphabetical indexes.

Horn reports three evaluative studies. These used information map books on various topics in mathematics, which were developed especially for the experiments. The length of the texts ranged from 84 to 151 pages, and they were aimed at college students in behavioural sciences. The materials were
self-instructional and intended for students with a minimal background in mathematics.

The first series of tests were essentially try-out experiments, which led to some modifications of the text. The subjects were 22 students in the psychology department of Tufts University. Two post tests were administered; one after an hour and a half of supervised study, and one after a further week of unsupervised home study. In addition, there were attitude questionnaires before and after the supervised study period. There were learning gains on both post-tests, though considerably less on the second one. The authors suggest that this may be because many of the students did not in fact study the book at home. In general, there was a highly favourable attitude towards the materials. The authors note that these results can only be taken as pointers, since certain features of the experiments, in particular the post-tests, were not rigorously controlled.

A second evaluative trial was carried out at Harvard. The material was an extended version of the text used in the first series. The aim of the experiment was to investigate certain visible structural aspects of the information maps. The subjects were 52 graduate students in the School of Education, who volunteered out of a class of 66. These were assigned randomly to two groups, and given either an information map or a prose version of the materials. The prose version had no visible structural features such as boxes, charts, labels, unit pages, but retained the same sentences
and feedback questions. The difference between the two versions lay in the visible structuring features. Attitude and achievement tests were administered before the materials were distributed. The students were then given a version of the text, and told to study it at home, recording the amount of time they had spent in each session. A week later, a post-test lasting ten minutes was given to 41 subjects, and a post-study attitude questionnaire administered. Finally, the subjects were allowed to take away and keep one of the versions. Although the gain scores from pretest to posttest were significant for both groups, the difference between the groups was not significant. The attitudes of the students towards both versions of the text were favourable; for example, over 90% in each group said they would recommend the material to another student. The authors, in discussing the results, suggest that the lack of difference arising from visible structuring features may be due to the fact that this was simply a 'one-time read-through':

The visible features of IM (Information Mapping) might be expected to operate primarily to alert one to the nature of the incoming information and to facilitate scanning for new material or for review. In a one-time read-through of a short text, perhaps one should not expect effects of the visible features to emerge very strongly. Rather it is in situations requiring information retrieval and integration where their advantages might show up. A different set of tasks in a less time-bound testing situation should be more sensitive to such effects.
This comment suggests the importance of the task specification as a factor in the retrieval situation; if the objectives of the course stress integrative learning, then one would expect the learners to use retrieval devices to organize the material.

The third evaluation series was again carried out at Harvard, with a longer text on sets and probability. Although this was the most rigorously conducted of all the experiments, it will not be reported in detail here, since it does not appear directly relevant. The aim of the experiment was to test the effectiveness of the text under two learning conditions; for an open-book and a closed-book examination. The text appeared to be effective in both cases.

Many of the features of Horn's information maps, such as local indexes, headings in the text, and charts and trees are similar to the retrieval devices listed in Chapter Six. In general, his concern with the organization of material in the text is the main concern in this work too. The difference in Horn's approach lies in the fact that he appears to have defined organization rather generally, and thus his information maps include features that are both organizational and descriptive. The difference appears to derive from a different theoretical starting-point. The rationale for the design of retrieval devices in this thesis comes from an analysis of the retrieval process; in Chapter Six, this provides not only guidance for the design of specific devices, but for the arrangement of devices as a system. Horn, on the
other hand, derives his rationale from a number of sources: research on various aspects of educational materials, in particular programmed texts\(^5\); work by psychologists on organizational aspects of learning\(^6\), and unspecified sources in human factors research and graphic technology. The result appears to be a theoretical confusion between organizational and retrieval devices in text materials. Horn recognizes the dual purpose nature of some of these devices:

Again we note that some of the features needed for easy reference purposes have already been mentioned as desirable on other grounds. For example, labels on information blocks aid in quick retrieval of ideas but they also serve to alert the learner to the nature of his learning task and prepare him to take in a specific kind of information.\(^7\) There is nothing wrong with having more than one reason for the inclusion of such devices, but as a research strategy, it would seem more advisable to attempt to isolate the various effects of devices before re-assembling them in a final text. The distinction between organisers and descriptors has already been made. In Horn's information maps, some of the features, such as the division of the text into information blocks, with a standardised format for each block, the use of previews, reviews and summaries, and feedback and self-testing questions, organise the learner rather than facilitate his organisation of the material; and this is the crucial distinction. Other features, such as local indexes, charts and trees and headings facilitate organisation of the material. No rationale is given for the design of these devices as a system; rather individual
justification in a form of previous research findings, is
given for the inclusion of each device. The result is that
it is not clear what is being tested in the experiments;
the effectiveness of organisational, or retrieval features.
In the second series reported above, where an Information
Map format was tested against a Prose format, both versions
had similar organisational devices (e.g. feedback questions)
but differed in some retrieval devices (e.g. labels, unit
pages). There are two points to be made about this comparison.
First, it was conceptualised in the form of testing the
'visible structural features' of the maps. The distinction
between organisers and descriptors is not drawn. Secondly,
the structural features which were tested were neither
tested individually, nor designed as a system, to complement
each other. It is not possible, therefore, to infer from the
results what the effectiveness of specific devices was.

Although Horn's work has interesting features, some of
which are quoted in Chapter Seven, his failure to distinguish
between devices which organise the learner and devices which
facilitate organisation by the learner, is a source of dif-
ficulty in relating his work to the present work. As a
research strategy, it seems more useful to separate the
processes of organisation and retrieval as far as possible,
and this is the line adopted in the final chapter here.
4. Textbooks as Information Stores: Comments

The rest of the literature on this subject is based on experience rather than experiment, and can be summarised briefly. Pressey, contrasting conventional texts with programmed texts, argues that the first allow the learner to 'move about in the material':

For a learner with reading-study skills, conventional textual matter orders and structure its contents in paragraphs and sections and chapters, exhibits that structure in headings and table of contents, makes all readily available in an index with page headings and numbers. The learner thus has multiple aids to the development and structuring of his understanding. If need be he can, with a flick of the finger, move about in the material; he can skip the already known, turn back as a result of later felt need, review selectively.

Smith and Smith quote Pressey with approval, and make a similar point, which they relate to their concept of spatially, as opposed to temporally, organised learning.

There are many sources of spatial organisation in school learning, not the least of which are the design features of ordinary textbooks. The subject matter in a book is arranged in paragraphs, sections and chapters, set off by headings in various qualities. These organizational features generally outline the logical structure of the specialised subject matter of the book and give the student a framework within which more detailed facts can be arranged and remembered.

This is an argument based on organisation rather than retrieval, but the spatial organisation of the text can also be considered a retrieval device since it allows the reader to divide the text into sections as he scans it quickly, choosing relevant sections, and passing over others. The idea of spatial organisation reinforcing or acting as an alternative
to temporal organisation is developed in chapter Eight, which deals with structural tables, and diagrammatic representation of content structure.

Barnes, discussing the use of textbooks in class, argues that the selective use of a textbook goes against the design of the book.

Most textbooks are built on their own sequence, in relation both to the series and to the individual volume. Information depends on previous information for its supporting explanations. Textbooks are not intended to be used selectively, and isolated portions may not contain a sufficient number of details and supporting facts to stand alone.

This argument applies to the use of isolated sections of several books; it does not hold for the non-linear use of all sections in one book. In the first case, the reader is taking one section out of its context. In the second, he is rearranging the sections in the order that suits him.

Ausubel, drawing a distinction between 'perceptual organisers' and 'integrative organizational devices', which were described earlier in the section on organisers and descriptors, gives the first the status of mechanical aids.

Perceptual organizers, in contrast to the integrative organizational devices just described, merely provide built-in mechanical aids that make the material perceptually more salient and apprehensible, or otherwise facilitate practice. These include rhythmic aids, vocal emphasis, the isolation and familiarization effect of underlining, and the "fractionation" effect (breaking of wholes into parts) of providing headings and subheadings. Under certain circumstances, however, some perceptual organizers can be said to have true integrative effects (e.g. underlining that helps make ideational distinctions or emphasizes central concepts; headings that reveal the organizational structure of the material more closely).
Ausubel does not consider these devices as retrieval devices, and thinks solely in terms of organising the learner's perceptions of the material. He does not, for example, discuss the possible effects of linking headings in the text with a list of headings at the beginning (table of contents). The conceptual framework provided by retrieval concepts and processes is missing.

§ Conclusion

It is difficult to draw any conclusions for this thesis from the research reviewed above. Apart from Horn's work, there appears to have been very little research done of textbooks as information stores, and in the two earlier experiments that have been reported, the concepts and models of the retrieval process were not used. It has been suggested that Horn's work has not distinguished sufficiently between organisers and descriptors in the text. No research has been found which deals with indexes, tables of content or cross-references. In no case do devices appear to have designed systematically to supplement each other.

Research on learner-control of sequencing is reviewed in the next chapter.
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56. *ibid.*, p.64.

57. *ibid.*, pp.8-10.

58. *ibid.*, p.11.


60. *ibid.*


63. BARNES, F.P., *art.cit.*

64. AUSUBEL, D.P., *op.cit.*
CHAPTER FIVE

LEARNER CONTROL: AN ANALYSIS OF RELEVANT RESEARCH

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CHAPTER FIVE

LEARNER CONTROL: AN ANALYSIS OF RELEVANT RESEARCH

1.1 Introduction

The question of control in the learning situation has arisen frequently in this analysis. Lumadaine pointed out that the textbook did not control the behaviour of the learner enough to make it a predictable means of instruction. Control, or manipulation, figured in his definition of instruction. Paisley and Parker described a retrieval system as a receiver-controlled communication system; translated into an educational context, this becomes 'learner-controlled'. In this chapter, therefore, relevant research on learner-control will be analysed. The purpose of this is to discover in what, if any, learner-control over certain elements in the learning situation increases learning or motivation.

1.2 The Scope of Learner-Control

The term 'learner-controlled' is not a precise one, and is difficult to distinguish from other terms like 'student-centered' and 'self-directed' or 'self-organised'. These can be contrasted with teacher-centred or instructor-centred teaching. Learner-control also needs to be distinguished from independent learning, and individualised teaching.
Independent learning can be taken to mean studying by oneself, at home or in a library, rather than in groups or with the contact teacher; it can also denote some degree of learner control in the situation, as in the phrase 'independent scholarship'. 'Individualised' teaching and learning means that the course has been modified in some way to suit the individual in question; the learner, given some control over the situation himself, may do this; but it can also be done by a teacher or designer. So although learner-control implies individualisation, the converse is not necessarily true.

1.3 The Objects of Learner-Control

Learner-Control can be more satisfactorily defined by listing the elements in the learning situation over which the learner may have control.

a) **Objectives.** The learner may decide his own objectives or arrive at them by mutual agreement with the teacher.

b) **Assessment.** A learner may have some say in the methods of assessment, as part of a more general agreement about the nature of the course.

c) **Sequencing.** A learner may determine the sequencing of the course, or of units within the course.

d) **Materials.** The learner might have some choice in the materials used in the course.

e) **Methods.** Teaching methods may be decided on by mutual agreement between learner and teacher.
f) **Media.** The student might have a choice of media if the same information were presented on more than one medium.

g) **Pacing.** The learner may be able to go at his own pace, rather than that of the group or of the teacher.

h) **Timing.** The learner may be free to choose when he shall study, e.g. in the afternoons, or in the evenings.

i) **Location.** The learner may be free to study at home or in school, as he wishes.

This list needs to be qualified in several ways. In the first place, the resources are not usually available to allow the learner so many choices, even if it were desirable. Secondly, some choices preclude others; the learner cannot opt for group discussion and home study. Thirdly, the degree of control is not specified, and is difficult in some cases to specify; the mutual discussion of objectives may lead to a compromise in which it is difficult to determine the amount of control exercised by the individual learner, the learners acting as a group, and the teacher. Learner-control and teacher-control are best seen not as opposites, but as two ends of the same continuum.

1.4 **Learner-Control of Sequencing.**

In an information retrieval system, the learner or user has control over the sequence in which he retrieves information. He may also control the scope of the information if
he does not have to retrieve the total store. This can be explained by referring to two situations. In the first, a learner is given a textbook with retrieval devices; he will be tested on the whole book. Therefore he must use the total store of information, although he can use it in any sequence he wants. In the second case, the learner is given a project to do, and a store of information which he can use. In this case, it is unlikely he will want to or be expected to use all the information available; he will select from the total store (e.g. a collection of documents) and retrieve as much as he needs. Thus he controls the scope of the information as well as sequence.

The other objects of learner-control listed above may affect his control of sequencing, but are not directly relevant here. Control over pacing is possible even when there is no control over sequencing, as with self-paced programmed texts. Self-pacing is not a unique attribute of retrieval systems. As learner control of sequencing is the only object of control common to all retrieval systems, and characterizes the search mode described in the third chapter, it is the only aspect of learner-control which will be considered here.

2.1 Sequencing: Research on Logical Sequencing.

It is worth reviewing briefly, before examining learner control of sequencing, logical sequencing of content by the
teacher or designer. This research, which was conducted into the sequencing of frames in programmed texts, has been reviewed and analyzed by Niedermeyer. He notes that many programmers, among them Skinner and Markle, have emphasized the importance of careful sequencing, and then reviews a number of experiments which attempt to test this assumption by comparing the effectiveness of scrambled programmes, in which the logical order of frames has been randomised, with the original versions. Only one of these reported any significant advantage for the logical version on post tests, but Niedermeyer suggests that some of the experiments had methodological weaknesses which might invalidate their results. However, he also describes a more recent experiment of his own, which led to the conclusion that "for short (less than two hours) programs, sequence may not be so crucial to cognitive outcomes as has previously been thought". Niedermeyer considers various explanations of the results of the experiments. One of these is that with scrambled versions, learners have to develop their own search strategies and thus structure the material themselves.

Logically-ordered, small-step, minimal-error-rate programs that are held in such high esteem at present may effectively promote desired cognitive outcomes, but, through overuse of spoonfeeding through sequence, may not promote desirable study skills and searching behaviors.

He concludes by quoting Mager: "Where it is necessary to teach one thing before another, do so. But be careful!"
There isn't nearly as much reason for this kind of sequencing as instructors like to believe.\(^8\) (author's italics)

The fact that logical sequencing by the instructor has been thrown in doubt does not automatically mean the learners would do any better by controlling their own sequence. Evidence for that must come from experiments in which learners have control. But the above work does show that the notion of logical sequencing by the programmer or course designers is open to investigation.

2.2 Sequencing: Research on Learner-Control

Research on learner-control of sequencing appears to date back to an experiment reported by Mager (1961)\(^9\). This is followed by further experiments by Mager and associates\(^10,11\), and by Campbell\(^12,13\). Silberman et al.\(^14\) also report some work, and Horn\(^15\) has reported an interesting use of learner-control with a collection of materials. Relevant work by Jahoda and Thomas\(^16\), and Thomas and Augstein\(^17\) at Brunel University is also reported here. No recent summary of research on learner-control of sequencing appears to be available, apart from a very brief overview by Stolurow\(^18\). Personal inquiries to both Mager and Campbell produced no work more recent than what is reported here.

Mager's starting point in his first experiment\(^19\) was the idea of a 'logical' sequence stressed by programmers. He argues that 'logical' in this context implies meaningful to the user, but that the user is not usually consulted in
The purpose of the investigation was to see if learner-generated and instructor-generated sequences were similar for the same topics, and to discover if there was any similarity among the sequences generated individually by each learner.

Six adult students were allowed, individually, to ask an instructor any questions they wished about electronics. All the students had expressed a wish to learn something about the subject, and all were convinced they knew very little about it, although a pretest showed that each one in fact had acquired a certain amount of information and misinformation on the subject. The instructor was to act simply as a resource, answering questions, but guiding or controlling the students as little as possible. After an initial period in which the students doubted the sincerity of the instructor's role as a mere resource, they began to put questions to him, often relating them to their previous experience. It soon became apparent to the teacher that their 'logic' and his did not coincide, and he found it difficult to follow their trains of thought. Mager points out that it is usually the student who has this difficulty:

*It is a simple matter for an instructor to present material in a sequence which is meaningful and "logical" to him. It is entirely another matter to present information in a sequence which is "logical" to the learner. If the instructor finds it difficult to keep up when the sequencing of content is controlled by the student, what kind of obstacles must the student be facing when the instructor controls the sequence?*  

(author's italics)
Mager found that the students' sequences started with quite different topics than those typically found in written courses on the subject. They tended to start with topics that related to their own experience. Secondly, although no common objectives had been specified, there was some commonality in the early stages of the sequences, although later on they tended to diverge. A third feature of the sequences was that the students were initially interested in the concrete rather than the abstract, in things rather than in theory, and in how things happened, rather than why.

Mager drew several tentative conclusions from this experience. Having established that learner-generated and instructor-generated sequences were different, he suggested that the next step would be to see which one was more effective. He also suggested that the learners' motivation increased with the amount of control they were given, because they participated more actively in the organisation of the content. Thirdly, he argued that adults could use this control to relate new matter to previous knowledge:

Further, the findings suggest that, if an adult learner has been provided with behaviorally stated objectives, and with control over his learning, he will reach the objectives by dovetailing what he needs to know with what he already knows.  

Mager regarded this experiment as a starting-point rather than something conclusive. The number of students was small, the procedure relaxed, and no attempt was made to measure learning. Nevertheless it at least suggested that increased control brought with it increased motivation.
A second study was conducted soon afterwards by Mager and McCann, this time in an industrial training setting. This study combined Mager's interest in learner-control with his emphasis on behaviorally stated objectives. The occasion of the experiment was the development of a new factory engineering course, which had previously lasted about six months, and consisted of classroom instruction and departmental work. In the new course, it was planned to provide students with precise objectives, but not to hold classes unless the students asked for them. There was not time to develop detailed objectives for the first course, so the students had to make do with a general description of objectives and subsequent clarifications from the course supervisor. They were told where and from whom they could get information in the factory, and the factory workers were told to answer the students' questions. The trainees were six engineers. A criterion test was not administered at the end, but what evidence there was (mainly subjective, from co-workers) suggested that the trainees were ready to start work after three months instead of six, and seemed to be competent.

The experiment was repeated the following year. This time the learners were given detailed objectives as well as control over their curriculum. They were also given some reference materials collected by the previous year's students, and a few texts on specific topics. The results were even more striking; average training time was reduced to 7½ weeks,
the trainees seemed more competent and confident than previous groups, and nothing that happened in the subsequent six months contradicted this.

On the basis of two other studies reported in 1965, Mager and Clark suggest that adults are likely to start in any new course with some previous knowledge:

The general conclusion we draw from these studies is that adult students are likely to enter a learning situation with a significant amount of relevant knowledge; in other words, they are likely already to know something about that which is to be taught.

While this may be true in every case, it does provide another possible reason for allowing adult learners control over sequencing.

There are now four distinct reasons why learner-control of sequencing might be useful for adults:

1) It allows the adult to relate new information to his previous experience, especially at the outset of the course.
2) It allows him to omit what he already knows.
3) It enables him to individualise his own sequence at all stages.
4) It increases motivation through increasing participation.

Mager and Clark suggest the need for 'curriculum-generating machines' which would construct courses to bridge the gap between what the learner knows already and what he is expected to know by the end. But, they continue, the adult himself might be able to do this best:
In the absence of a curriculum-generating machine, the adult learner himself might be a better judge of what he needs to add to his current knowledge in order to reach some given set of objectives than is a textbook, writer, instructor, or programmer. Given half a chance and a set of reasonable objectives, he will probably generate for himself a curriculum that will lead him to achieve these objectives.

It would be possible for the learner to generate such a curriculum for himself only if he had good access to information and materials; hence the need to study retrieval problems at all levels from the library to the single textbook.

In another review of research into learner-controlled instruction, Mager (1964) suggests that it may be instructive for the teacher as well as for the student to have the teacher act merely as a responsive resource:

The process of locking an instructor to the control of a learner appears to have possibilities not yet explored. One of these has to do with instructor training. For an instructor to behave as an information store rather than an information transmitter is not easy, and for him to behave as an information-retrieval system under the control of a student is most painful. But the person who will put himself under the control of a learner for a few hours (and who actually abides by the rules of the game) will see something he may never have seen before.....he will actually see someone learn. While experiencing the frustration of being forced to explain something to the learner student's satisfaction, he will discover how he is mismatched to the learner in the assumptions he makes about what the learner already knows and wants to know and in his assumptions about the most meaningful sequence in which to proceed.

While this technique is obviously very costly in terms of teacher-time, Mager believes that it can be an illuminating experience on both sides. He sums up by describing the possible long-term effects of giving the learner control:
Perhaps it would be as useful to give the student powerful techniques for effective inquiry, and substantial control over his learning activities, as to give programmers effective techniques for programming. Perhaps by the process of providing the student with tools that will give him confidence in attacking any new learning problem, we could — even — come closer to realizing the goal of making learning a lifelong interest.

This is rather a different argument in favour of learner control; instead of stressing its immediate effects on learning and motivation, it suggests that giving the learner control may help him to develop long-term, transferrable study skills. It is an argument which has weight in adult education since it envisages a kind of learning momentum which could be sustained right throughout adult life.

Another early piece of research is reported by Silberman et al. This involved a comparison between material presented in a linear programme, mounted on cards, and in a textbook format. The authors hypothesized that the second would be more effective, because of 'the ease of reviewing and the facility for skipping ahead with the textbook format'. The subjects were junior and senior students from high school, randomly assigned to three groups of seventeen. The learning task consisted of some topics in logic. The first two groups received the information in programmed form; the second of these was allowed to refer backwards but not forwards in the programme. The third group was given the information in paragraphs, with all the answers to the multiple-choice questions in each frame of the programme incorporated into the text. They were told to study the material in any way they pleased. On an immediate post-test, consisting of
24 free-response and 24 multiple-choice questions, the textbook group were significantly better than either of the other two. The difficulty in generalising from this experiment lies in two things. First, the difference between the textbook version and the others lay not only in control over sequencing, but in the response made as well. The first two groups were instructed to give a covert response to each item, and then compare their answer with the correct answer which was given on the back of the relevant card. The textbook group got a different format:

Each item was converted from a question into a statement by incorporating the correct answers, eliminating distractors and filling in blanks. These statements were then organized into paragraphs.

A true test of control over sequencing would have to compare standardised content, the versions differing only in the provision of retrieval devices. Secondly, there is no indication what retrieval devices were provided, if any; it would be useful to know for example if the paragraphs had headings, or were numbered, or if a table of contents at the beginning was provided. The general difficulty is that 'textbook format' can be interpreted in various ways; the only aspect being investigated in this thesis is control of sequence through retrieval devices.

Campbell (1964) reports a series of five experiments in self-directed instruction. These covered five different subjects, and were conducted with high school students. In the preamble Campbell writes:
Control of the learning process by the learner is not feasible with group methods of instruction, such as lecture and discussion. Individualized instruction permits learner control, yet new developments in education, especially programmed instruction, are predominantly headed toward giving the student even less control than he has with an ordinary textbook, for example. This may be a good thing in some cases, but for many learning objectives, perhaps most, there is reason to believe that we should be moving in the opposite direction, toward more freedom and control for the student, not less.

He bases these views on two criteria; meaningfulness, and motivation. Of the first, he says:

One man’s meaning is another man’s nonsense. When meaningfulness is to be evaluated every few minutes or even oftener, I seriously doubt that a teacher or program can do it as well as the student himself can. If the instructional situation were designed to quickly offer the student alternative examples and ways of learning, the student might be better able to direct himself to more meaningful study than could a program or teacher.

Campbell is here considering the scale of control, and arguing that the source cannot exercise minute controls as effectively as the learner. As regards motivation, Campbell suggests that greater learner control may increase motivation to learn; on the other hand, he warns that if students do not want to learn in the first place, greater freedom may worsen rather than ameliorate the situation.

The formats of the materials for three of Campbell’s experiments were as follows:

a. A linear self-instruction programme, without branching, which contained questions varying in difficulty. The programmes were self-paced, and
students could consult the teacher at any time. The students had to go through the programmes in the fixed sequence, answering all the questions and reading all the material.

b. A self-directing format, consisting of the following:

i. A short basic text (a short linear program with only occasional questions).

ii. Supplementary questions and explanations.

iii. Self-testing questions.

iv. A two-page outline of the entire lesson.

These four components were physically separate, but cross-indexed to each other by numbering and lettering of pages. The students were free to use them in any sequence or way they wanted, and could consult the teacher at any time.

The difficulty here again is the comparability of content; it is not clear whether the first three components of the second version added up to the first version. If that were the case, then the two-page outline and the cross-referencing system were the only difference. Even in that case, unless the outline was numerically linked to sections of the other components, it would be acting as an organising rather than a retrieval device.

Since the relevance of all of these experiments is not certain, for the above reasons and also because they were conducted with schoolchildren, the results can be
summarised briefly. In two of these experiments, one on mathematics and one on geography, there was no significant difference between the groups as measured by immediate and delayed post-tests. In a third experiment on mathematics, where students were coached after the first week on both self-direction and linear study, the self-directing group were significantly better. This coaching, which lasted four hours in all, took the form of discussion and on-the-spot advice for the self-directing students, and of talks and discussion for the linear programme group. Commenting on this result, Campbell writes:

The key to releasing students' capacities for effective self-direction in mathematics seemed to be coached practice. Why did practice in self-conscious appraisal by the student of his own learning activities help? Our classroom observations and early individual interviews strongly suggested the following as the primary reason: We broke their set for passive instruction, a set to do just as they are told, which is deeply ingrained after a few years of formal education. It seems to take a lot of jogging to get students out of this passive set. Verbal instructions alone seldom suffice.

A similar point has been made by Thomas and Augstein\textsuperscript{37} in this country. This is an important question for adult educators; if formal schooling ingrains this passive attitude in people, then one of the main tasks of adult education might be to teach people to start organising their own learning, rather than continually relying on the source to organise the learning situation for them.

In another of Campbell's experiments\textsuperscript{38}, this time on global geography, the format differed slightly in that the
self-test questions were incorporated into the programme in both versions, rather than being a separate component for the self-directors. Criterion tests were given immediately afterwards, and also after ten days and after five months. The results showed no advantage in learning for either version, though the students preferred self-direction. A third group was given no programme or self-testing questions at all, but presented with a four-page outline of the course, an atlas, and general classroom reference materials. They were free to consult the teacher privately. This group, which was of the same average ability as the others, learned the same amount in half the time, and retained it equally well after five months. But they ended up by hating this method, having found it extremely boring.

In a later experiment, Campbell and Chapman (1967) tried to test long-term effects of learner control. This was on a course on global geography, and the subjects were this time elementary school children. The formats of the materials differed in much the same way as the formats described above. The learner-controlled classes received the following materials:

At the start of each unit each LC S (i.e. learner-control student) was given a 10" x 12" cardboard expanding vertical file containing his mimeographed learning materials. The components described above were color coded. In the back of the file were the lists of objectives for that unit and for previous hierarchically related units, a unit glossary and a study guide which described the kinds of learning materials and tests available and suggested ideas for planning one's own study. The remaining slots in the file were lettered A to Z as were the objectives.
The course lasted eight months, and tests at the end showed no significant difference in performance for program-controlled and learner-controlled groups; the latter however seemed to have developed more interest in the subject, as indicated by answers to questionnaires.

It is difficult to get any clear picture from these experiments as a whole, and before any conclusions are drawn from them, it may be useful to review two rather different studies which have a bearing on the subject of learner control.

The first of these, on 'Learner-Controlled Use of Information-Retrieval Systems' is reported by Horn (1964). Faced with the problem of running short workshop courses on programmed learning for students of widely differing backgrounds and amounts of experience, Horn and his colleagues first planned a 'middle ground' course which they hoped would meet the majority of needs. However, further consideration of the problem of individual differences led them to design a retrieval system which would allow the students individually to get hold of the materials they needed. Each student was provided with a list of objectives and was told to find out what he didn't know already. Thus provision was made for the 'dovetailing' process mentioned by Mager. The information store consisted of a large number of small items contained in folders and files. These items, which consisted of anything from a few sentences to 2,000 word articles, had been created.
by cutting up and collating a large number of books, articles, pamphlets and programs. Each item was given a descriptor, and indexed. The retrieval system was only one part of a course which included lectures, demonstrations and discussions. The authors found that the students responded well to the system, and used it intelligently:

The instructors noticed that the students seemed to prefer using the information-retrieval system to reading the other material available in our library. In many cases, students were found to be reading articles and parts of articles from the IR system's folders in preference to reading the bound volumes containing the same articles. We interpreted this in several ways. In the first place, large textbooks and bound copies of articles are rather forbidding. It is a common experience to flip through many pages before coming upon those materials which you are especially interested in at that moment. Second, the ability to scan the tabs of folders and pull out the information immediately seems to have been a motivating factor.

In addition to this benefit for the students, the teachers found that the system saved some teaching time, because they were able to refer students to specific items in it to correct faults in practice programmes. The organisers made further attempts to discover the exact needs of the students by collecting their queries:

Students in their second and third weeks of a course in programmed instruction at Teachers College come one at a time into an office to use the IR system. After they write a question, they are given a folder containing information relevant to their question. They comment on whether they feel that the folder has been of use to them, and then ask further questions of the system in writing.
The authors report, in conclusion, that they are trying to extend the capacity of the system, and investigating the possibility of designing a classroom 

system 'from the ground up'.

Horn's work has been concerned with a collection of materials rather than with single texts. Nor has he attempted to measure the effects on learning of the introduction of the system. Nevertheless, it suggests a useful line of development.

The other relevant series of experiments have been carried out by Jahoda and Thomas, and Thomas and Augatein at Brunel University. These have investigated the ways in which students extract information from books and lectures, and the development of reading 'strategies'. They have not been concerned with the effects of retrieval devices on these strategies. The authors again present the problem in terms of the locus of control in instruction:

To the extent that a student learns by using the checks which the author has built into his material, his behaviour can be thought of as being controlled by the material. To the extent that he learns by using his own methods for checking and reviewing his progress he can be considered to be controlling his own behaviour.

In any practical example of undergraduate learning, one can trace out the movement of the locus of control between the student on the one hand and the teacher or the materials on the other.

The authors presented the students with three short passages on history, cybernetics and clinical psychology. These were in the form of booklets, with one paragraph on each page. There were no retrieval devices such as headings
etc., apart from the title. The way in which each student proceeded through the booklet was recorded as a succession of page numbers, and the time spent on each page was noted by the experimenter. The experiment showed that there were considerable differences in the ways students read the passages:

Students differed very much in the way in which they went through any passage. Some started by scanning rapidly through it and then going over it again selectively, perhaps even referring to what they took to be key paragraphs, four, five or even six times. Others spent much more time on the first reading and simply checked back to the important passages briefly. A few students started to read carefully through a passage and at some point found that they were no longer understanding it and came to a halt. They then began to refer back in a more or less organized way. One student read very slowly right through the passage and then said that he had learnt it. When he was taken back through the material, he described how he read a sentence and if he did not understand it, he re-read the previous sentence. Thus it was possible to differentiate between a number of different types of learning strategy and to begin to classify the nature of the monitoring or review mechanisms which students use to guide their learning behaviour. One striking difference between students was that some used the same type of strategy on all three passages although the difference in structure meant that it could not be equally effective for all three. Other students appeared to generate a strategy appropriate to the material.

These observations raise several questions. The first is the effectiveness of different strategies for different learners and types of material. Related to this is the problem of describing 'structure' in the material in an objective way. Thirdly, there is the possible effects of adding or subtracting retrieval devices from the material in question: would, for example, the provision of certain
types of headings change the reading strategies of learners? Would they have to be trained in their use?

Thomas and Augstein report five more experiments which continue this line of investigation. In their account of the rationale of the investigation, they argue that many school children, as a result of rigid control of learning situations by teachers, came to 'abandon personal responsibility for all but the lowest levels of self-organisation within their own learning activities, including reading'. They describe the reading process as follows:

Reading here is treated as an active process of meaning generation rather than a passive intake of information. The reader starts with a certain orientation toward and knowledge about the content of the text. The eyes are used to "map" his initial ideas and structure on to the material; i.e. to test out his ideas against the words on the page. The degree of linkage developed between the person and the text may be complex or it may only be superficial. This will depend on the subjective values which the reader uses to assess his learning. Any perceived mismatch will produce a feeling of "not understanding", but the reader will only perceive mismatch when his monitoring system contains the dimensions required to reveal it.

This shows that the authors are interested in investigating certain variables in the reading situation; the material, the subjective approach of the reader and his monitoring system. The main interest is in reading strategies used by learners, how these relate to other factors in the learners such as intelligence and personality, and how effective they are. On the other hand, the authors do not seem interested in the organisation of the material; they talk simply of 'the words on the page', and do not distinguish between words used in the text, and words used as descriptors for the text in the
form of headings or index terms. This is not to criticise their approach; they are controlling variables in the presentation of material, while investigating variations in reading strategy. This approach seems complementary to the one being advanced in this thesis; whereas Thomas and Augatein are investigating the human side of the interactive reading process, the concern here is with the nonhuman side, i.e. the design of the materials. So while their research does not have direct bearing on this investigation, it is still relevant.

Particularly relevant are their findings that the task definition influences the pattern of reading, and that certain types of strategies, including a search pattern which moves backwards and forwards through the text, seem more effective in general than others. On the first point, the authors report an experiment in which sixty students had to make a summary and answer two multiple choice test papers after studying a short text on genetic coding. The length of the text is not specified. Some students were pre-tested with a multiple choice test, and told to expect similar tests at the end; others were asked to read in order to produce a summary. All students had in fact both to write a summary and do multiple choice tests. The definition of the task influenced the pattern of reading:

Those associated with effective summaries usually consisted of a quick scan through the text, one or more slow reads with hesitations, followed by a "search read" in which the student looked backwards and forwards through the text. There were some detailed differences; the objective test readers who produced effective summaries
did less structural organising during the reading session but spent more time "thinking" before writing their summaries. The successful test paper readers who did not produce effective summaries all had within their records long, slow, even reads with hesitations, in which the position of the hesitations could be associated with successful completion of particular multiple choice questions.

This result shows that the definition of the task at the beginning as either an exercise in summarising or in answering objective-test questions influenced the ways the students studied the material.

On the second point, Thomas and Augstein simply report that in a previous experiment, patterns of reading were significantly related to results on multiple-choice tests.

Long steady reads with hesitations were successful as were "search" patterns showing movement backwards and forwards through the text. It was possible to identify the points in the text at which hesitations took place and to relate these significantly to success in answering particular multiple choice questions.

These experiments have been conducted recently (1969) and further work is planned to follow up these investigations, and possibly arrive at diagnosis and training of individual reading strategies.

3.1 Conclusions

It is difficult to arrive at any firm conclusions from an analysis of the foregoing experiments. For convenience, the findings can be divided into two sections, relating to

a. Learner-control in general,

b. Learner-control of sequencing.
3.2 Learner-Control: General

The two main advantages claimed for learner-control in general are that it allows the learner to individualise his instruction, thus making it more effective, and secondly that it develops a greater set of participation in the instructional process. Although both these seem to have happened in Mager's and his associates' experiments, it is difficult to generalise on the basis of these findings. The experiments were not well-controlled, the number of subjects involved was small, and they may have been of higher than average ability. Mager was however working with adults, and some writers have suggested that both greater individualisation and greater control over the learning process are needed by adults than by school-children. In the heterogeneous adult class, containing people from different backgrounds, with differing previous knowledge and educational attainments, individualisation is a problem, and giving learners more control may be a way to allow them to select what is most relevant, and least immediately threatening to them. This could be a useful strategy for at least the early parts of a course. But such intuitive speculation needs to be investigated. Mager's work, in this respect, forms a suggestive start rather than a conclusion. The other point to be noted is that Leith has reported findings which suggest a relationship between personality types and the amount of control or structure in the learning situation. It appears that introverted people
may become over-anxious in a situation where no firm guidelines are provided. It can be expected that some people would be happier at the prospect of controlling their own learning than others; the question then arises, should it be an objective of the course, or of adult education in general, to teach those who are unwilling to assume some control for their own learning to do so? For this is what 'learning to learn' involves. Such questions can at least be thrown open to debate.

3.3 Learner-Control of Sequencing

In the control of sequencing, it is possible to identify the following main variables:

1) The definition of the task, as perceived by the learner.

2) The learner himself: his previous knowledge, capacity to organise and evaluate his own learning, personality and attitudes towards the task and material.

3) The Material: its structure and content.

4) The Retrieval System.

This study is concerned with the last of these variables. The claims made for learner-control of sequencing can be divided into two categories, cognitive and affective:
Cognitive

The student can learn the material more effectively through being able to:

a) Omit what he already knows.

b) Enter the material at the point or points which relate to his previous experience.

c) Control his search pattern at all points, according to his own criteria of meaningfulness.

Affective

a) The learner is highly motivated because he is involved in structuring the information flow, rather than simply receiving information.

It is difficult to link any of the experimental findings individually with any of the cognitive claims. Mager and Horn both report a saving of time resulting from (a). Better achievement on a post-test might be due to any one or more of the three cognitive points listed above. There appears to be no formal evidence that 'dovetailing' (cognitive b) or 'meaningfulness' (cognitive c) occur consistently with adults, despite assertions that they do. With regard to the affective claim, increases in motivation were reported in several experiments reviewed above. Increases in motivation may be expected to depend mainly on three factors: the difficulty of the task, the personality of the learner, and the previous knowledge of the learner. If a task is very
difficult, and the learner fails to master it, or parts of it, the motivation deriving from involvement is likely to be outweighed by the failure to achieve anything. As regards personality, it might be expected that some people are more persistent and capable of controlling their own instruction than others. Thirdly, unless a learner has a reasonable amount of previous knowledge with which to approach a new learning task, it may prove too difficult for him.

It appears from the foregoing experiments that further research into learner control of sequencing would be justified for as Campbell reports, in no cases did it have an adverse effect on learning. However, the early optimism of Mager and McCann's early work has not been sustained. In relation to this study, the point to be made is that forms of organisation which allow the option of source or learner control are likely to be more effective than forms which only allow learner control. The organisation of texts as stores of information does not preclude their organisation as sequences; in which case, the learner can choose either to dictate his own search pattern, or to follow the source-controlled sequence. The arguments for having retrieval facilities in the textbook do not therefore depend solely on the arguments for learner control; if it can be shown that for some students, in some situations, learner control is advantageous, this is enough justification for designing the book for retrieval. It is felt that the research reviewed in this
chapter provides this justification, although there is room for further work designed specifically in relation to information retrieval from textbooks.

The relevance of the work being done at Brunel\textsuperscript{64} is clear. It has been shown there that learners adopt varying reading strategies even without the aid of retrieval devices. Retrieval devices can be expected to facilitate a choice of strategies, and make it easier for the students to develop appropriate strategies. Although several experiments, e.g. Campbell's\textsuperscript{65} and Horn's\textsuperscript{66}, used materials which incorporated retrieval devices, the effects of these were not isolated from other effects arising from differences in the presentation and content of the material. To test the effectiveness of devices, it would be necessary to compare texts which differed only in the existence of those devices.

Campbell\textsuperscript{67} reported that coaching in techniques of self-direction improved the effectiveness of learner control significantly on one occasion. In the light of this, and the other work reported in this chapter, it can be suggested that research in this area might concentrate on two things; the presentation of the material, including retrieval devices and format; and means of developing self-organising techniques in learners. In the next chapter, the first of these will be pursued, and an attempt made to provide a systematic framework for the design and testing of retrieval devices.
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CHAPTER SIX

INFORMATION RETRIEVAL FROM TEXT MATERIALS

1 Introduction

2.1 The Process of Information Retrieval
2.2 Query Formulation and Control
2.3 Scanning and Switching: Matching
2.4 Locating of Information
2.5 Evaluation of Information Retrieved
2.6 The Process of Information Retrieval: Summary

3.1 Retrieval Devices in Text Materials
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4.1 Retrieval Devices and the Retrieval Process
4.2 Query Formulation and Control
4.3 Scanning, Switching: Matching
4.4 Location of Information

5 Conclusion
1. Introduction

The main theoretical point of this thesis was made in the third chapter, in which it was suggested that it was more useful, in an educational context, to examine the process of information transfer than to conceptualise information as an entity; in particular, it was suggested that the connotation of 'facts', implicit in Lumadaine's distinction, and explicit in Burns and Brooks' comments was inessential and even misleading. It is now time to look at the practical implications of this change of emphasis, and particularly to examine the problems of designing textbooks as stores of information.

In the two preceding chapters relevant research in two areas has been analysed: the use of textbooks as information stores and the effects on learning and motivation of giving learners control over sequencing. These two areas constitute the material and the human sides of the process, respectively. In the first case, only three experiments could be found which tested the use of retrieval devices. In none of these experiments was the rationale given solely in terms of retrieval. The designer cannot look in this direction for firm guidance on problems of textbook design. On the human side, the research into learner control of sequencing seemed contradictory, with some writers, like Mager...
suggesting that there might be definite gains for adults in learning and motivation resulting from control over sequencing, and others, like Campbell and Chapman, who see the main benefits of learner control accruing to the teacher or programmer, in the form of a redirection of effort:

The main implication of the present research may be an economic one. If students directing their own learning can achieve at the same academic level as students following the best program we could devise for them, perhaps we should not invest so much effort in arranging the exact format of instruction, but rather in other areas of need such as clarifying objectives and relations among objectives, improving the basic content elements of instruction and the means for evaluating progress, and motivating the learners.

These conclusions can be stated negatively or positively: learner control can be said to be no better than source control; or, it can be argued that source control is no better than learner control. The results are certainly not conclusive, and more research needs to be done in a specifically adult context, where Mager's work started.

None of the research reviewed in either chapter focussed exactly on what was wanted: assessment of the effectiveness of providing learners with a text explicitly designed for information retrieval. The design of such a text will be the subject of this chapter, and it is hoped that the process of information retrieval, as described here, will provide a rationale for the design and use of the various retrieval devices. The subject will be tackled in three stages:
a) An analysis of the process of information retrieval (Sections 2.1 - 2.6)
b) A description of various retrieval devices in textbooks as they appear at present (Sections 3.1 - 3.7)
c) Suggestions for organising these devices in the light of the retrieval process (Sections 4.1 - 4.4)

2.1 The Process of Information Retrieval

A clear description of the process of retrieval has been given by Meadow. Following his approach, the process will be divided here into four main stages:

1) Query formulation and control.
2) Scanning and switching; matching.
3) Location of information.
4) Evaluation of information.

As Jolley has noted, the retrieval process can be a continuous one, and the above divisions are more accurately seen as a cyclical process, where the last stage leads round to the first again. This point is emphasised in the section below on evaluation of information. The following description will concentrate on the mental and physical processes involved in retrieval; retrieval devices will be described in the next section.
2.2 Query Formulation and Control

The process of retrieval can be approached from either the organiser's end (source), or the user's end (receiver). If the latter approach is used, then the formulation of the user's query is the first stage in the process. But since there must be some information in the system before the user will think of using it at all, the system organiser has to prime the system with enough information to make it worth using. This involves predicting, to some extent, the user's needs. In the case of a general library service, the needs are ill-defined. However, in a teaching-learning context, both the needs of the user and the functions of the system can be related to the overall objectives of the course. This means that the information retrieval system must be a planned part of the teaching provision, rather than a loosely-organised extra. At library level, there must therefore be considerable cooperation between the librarian and the course designers and teachers. The librarian can have little idea what queries he will receive unless he is forewarned by the teachers; so that teachers must be able to predict the kinds of queries which will arise in order to allow the librarian to prepare for them.

At text level, the problem is somewhat different, since the scope of the queries is limited by the scope of the text itself. Within these overall limits, the scope of individual queries can vary a great deal, so the problem again arises
of how to predict the kinds of queries the users will put to the system. In the process of query formulation, there are three main factors: the course objectives, the learner and the information system. The queries that are formulated will result from interaction between these three elements. As regards course objectives, it is the learner's understanding of the course objectives, not the teacher's understanding of them, which influences him. Even if objectives are clearly and unambiguously stated, the teacher must be careful to ask Mager's question: clear for whom? unambiguous for whom? Just as with logical sequencing, where the teacher's and student's logic may not coincide, clarified objectives are only clear to the student if he understands the language they are couched in, and the reasons of their inclusion. Secondly, it may be expected that the learner's perception of the course objectives will change as he progresses, and brings new knowledge to bear on the situation. There may also be hidden objectives on the learner's side; he may decide that the stated objectives of the course are not the real objectives, (i.e. the ones that he will be examined on), or he may give priority over the course objectives to certain ones of his own. Thus a student might use a course as a carrier for his own aims; becoming competent in the course objectives, but putting more effort into related objectives of his own. Thus it seems important not only to state the course objectives clearly at the teacher's end, but also to
enquire of each student what his own objectives are.

Jahoda and Thomas make a useful distinction between two measurements of learning, in the teacher's and the learner's terms:

> Learning cannot be observed, it is always an inference from behaviour or experience. Teachers or experimental psychologists may infer that learning has occurred when a student's actions or verbal responses change in ways they have intended. What, in our study, we have come to call learning Type A is measured by comparing the learner's behaviour with the purpose of the teacher. On the other hand the inference may be made from the learner's point of view. A group of students, who as far as the teacher is concerned are all learning the same thing, may each define the learning task differently to themselves. Some may see it in terms of rote learning, others in terms of understanding; some may see it in terms of their ability to answer examination questions, others may feel that they are motivated by an intrinsic interest in the material. Learning which is measured by evaluating changes in behaviour against purposes which are expressed by the learner himself, we have come to call learning Type B. Thus, Type A and Type B inferences can both be made from the same behaviour, sometimes with widely differing results.

Even when objectives have been stated as clearly as possible, there is still room for divergence between what the learner understands of them, and what the tutor understands; in addition, the stated objectives may become secondary to hidden objectives on the learner's side (or even the teacher's side) which he does not reveal. In practice, then, and especially in adult education, with its typically heterogeneous groups of students, objectives represent an area of common consent which may have a number of individual fringes. In looking at the search patterns of individual students, the teacher should be alive to these
possibilities; unusual search patterns are better ascribed not to irrationality, but to objectives which have not become explicit.

The third element in the process of query formulation is the system itself; what the learner expects of it, and what he finds in it. If, for example, the objectives of the course and the descriptors of the system are very different, the student will find it difficult to translate the language of the objectives into the system language. For this reason, there must either be coincidence between the ways the two are expressed, or some aids to the process of translation, like scope notes. This translation process may occur also when the learner is trying to match his own terms with those used in the system. The language of the original query may not exist in the system, and the learner has to find synonyms or related terms before he can retrieve information. Thus a learner looking for information on 'learner-control' may find no such descriptor; if there could, however, be scope notes saying 'see self-direction' or 'see student-centered' Thus the query is controlled by limiting the number of terms that the query language can have. Just as the information system can stimulate interest in the learner by presenting him with descriptors, it also controls the queries he puts. Thus the first stage in the retrieval process is headed 'query formulation and control'. The learner begins to form queries as a result of considering the objectives, or following his own interests, or seeing what the system
has to offer; as soon as he starts to interact with the system, his original queries may become changed to fit the language of the system. Foskett suggests that this delicate matching of user's terms and system language, is the key activity of information transfer:

But the model activity of information service is not the translation of author's terms into an indexing language. If it were, how simple our problem would be. We should require no more than a sort of conversion table, which could always be brought up to date by the incorporation of any new terms used by the author, in a manner consistent with the index structure. No difficulty here; an author's text is a static, completed unit, which gives to all its terms a stated context. The real hub of information service, on the contrary, is to express an ill-defined, incomplete, and changeable thought pattern - the enquirer's - in terms that will bring out of a store information able to change that pattern into a coherent system corresponding with reality.

Foskett is describing an information service, where the common objectives of the users and organisers are likely to be less well-defined than in an educational context; nevertheless, the point remains that the system has to meet a variable and ill-defined pattern of concept association. Thus in the first stage of retrieval, the system both stimulates the learner to form queries and controls the queries he puts to it.

2.3 Scanning and Switching: Matching

The second stage begins when the query has been formulated in system terms. This is a continuation of the first stage, and there is no distinct break between them; but at
this stage, the user has a more definite idea of what he wants, and how to look for it. He sets about scanning the descriptors:

The human scanning of a document store or descriptor file for certain search words is rarely restricted to the selection of 'one-to-one matches'. In the first place, the searcher is on the look-out for synonyms, other words or symbols representing the same concept as he seeks. Instead of formulating a single search word in his mind, he may make a list of alternatives. Secondly, a searcher may bear in mind not only a particular word sought, but also words representing concepts more specific than the central search concept, or words representing more general concepts. For this particular search, he will treat these more specific and generic words as satisfying this search requirement. The searcher may have still other related words in his list.

The descriptors allow the user to scan a very much reduced version of the original; here again, it must be remembered that descriptors involve a selection from the original, and not necessarily the selection that the learner would have made. If the descriptor file is arranged systematically, the user can divide the materials into parts to be searched and parts to be left. This means that he does not have to scan all the descriptors each time he formulates a query; if they are arranged in groups, with specified reactions, the user can guess which groups are likely to be relevant and which not. This implies that there is a semantic structure in the text, which is reflected in the way the descriptors are arranged. To this, the learner attempts to match his own structure, again expressed in a network of descriptors. It is important not only to match the terms being used, but also the structures; this means that relationships between descriptors have to be indicated.
Matching is better seen as a matching of conceptual networks, expressed in descriptors, rather than a matching of descriptors in isolation. This may mean exploring structural displays of descriptors, like the table of contents and structural table (see chapter 8) rather than random displays like the index. The index is of course arranged in alphabetical order, but as Foskett points out, the alphabet is a conventional rather than a semantic order.

The second stage of retrieval continues the process of matching the user's query with the language of the system. In it, the learner is using descriptor files like the table of contents or the index, to scan, in a greatly reduced form, the contents of the store; if the descriptors are arranged systematically, he may confine his scanning to what seem relevant groups. The descriptors may be arranged according to a conventional order (the alphabet), or a meaningful order which displays relationships between them.

2.4 Location of Information

In the third stage of retrieval, the user, having found a satisfactory descriptor, notes the address of the information, and proceeds to retrieve it. This is usually a simple operation like looking up a certain page, or finding a book on a shelf. This stage involves a notation system, which can use numbers, letters, or both. These notation systems do not necessarily reflect accurately the relationships in the material. A book, for example, may be numbered by page,
by section, or in the case of a programmed text, by frame. Page numbering indicates nothing about the material except that the reader expects to find related material on consecutive pages. This may not always hold; pages 65 and 66 may contain the end of one chapter and the beginning of another respectively. Even section numbering gives only a rough guide; two subsections, numbered 3.2 and 3.3 may be far more closely related than two others, numbered 4.5 and 4.6. Notation used in retrieval systems is best viewed simply as a means of getting from the descriptors to the information itself, without indicating exact relationships.

2.5 Evaluation of the Information Retrieved

When the user finds the information he is looking for, he evaluates its usefulness. In some cases, it will be information he wants to learn, so as to be able to reproduce or transfer it to other situations; in other cases, he may use it as a stepping stone to move on to something more important. The point to be made here is that the information retrieved can lead to the formulation of a new query; as Vickery points out, the process can be a developmental one. In the case of the man who is looking up the time of a train, the process stops when he finds it; but in a learning context, the discovery of a new demand can lead on to another. It is thus misleading to think of queries originating entirely in the learner; the course objectives and the information retrieved from the system provide constant sources of stimuli to the learner to formulate new demands.
2.6 The Process of Information Retrieval: Summary

The advantages and difficulties of information retrieval all stem from one thing: the organised reduction of the original material which appears as the descriptor file. This reduction allows the learner to manipulate his search in a way that he could not do if he had to work with the actual material; but it also creates a bottleneck of terms and concepts in which it can be difficult to match the terms used in the system with the terms the learner uses. As pointed out above, though this appears as a problem of matching individual terms, it can more usefully be seen as a problem of matching structure, expressed in terms. The user's terms, too, are a reduction of a larger original store of information; this, like the external store may have some sort of meaningful order. Mager has already suggested that adults bring a good deal of knowledge to most learning situations. It is to be hoped that with a well-designed information system, this previous knowledge will act as a stepping-stone to the new knowledge, rather than as an obstacle. This can only be so if the system allows for the delicate matching process which runs through each stage of the retrieval of information.

Information retrieval systems may be set up for one of two purposes; either to save time, or to facilitate the manipulation of information. Although these purposes cannot be entirely separated, one or other of them usually predominates. In the first case, an information problem arises through having too much information to handle. A large
industrial concern may find itself in this situation, if it has large amounts of information coming in from branches all over the world, not to mention information about other companies and market conditions in various countries. This information provides the basis for decision-making in the company, and must be organised in a way which will allow facts to be assembled and trends discerned quickly. Complete searches of the store every time a decision has to be taken would be a tremendous waste of time and money; hence the need to organise the information for retrieval. This time-saving aspect of retrieval can also apply to individuals. A student attending a postgraduate course or doing research, can save a lot of time by organising all the documents, handouts, notes and books he collects into some order which will allow him to find what he wants without too much searching. If a student is taught how to retrieve information (e.g. from a library) he should also be taught how to organise the information he retrieves.

It is not, however, information overload which is the problem with retrieval from text materials. Here, it is the arrangement, rather than the amount of information which is the problem. Sequences and arrangements of information devised by the textbook writer or teacher may or may not correspond with the most suitable sequence for each individual learner. Mager has reported some evidence that they do not entirely coincide, and Campbell has suggested that the learner is in some cases the best person to generate his own
sequence. In order to do this, the learner needs to be able to manipulate the material, and this can only be done by reducing the material to something less than its original amount; that is, by using descriptors. The purpose of the manipulation is not to save time, but to form a pattern which coincides as closely as possible with the learner's needs. For this reason, the main difficulties in organizing information in an instructional context are likely to lie in the first two stages of the process, that is, query formulation and control, and scanning and switching, rather than in the third stage, locating the information. Location of information may be difficult where there is a large collection of material stored in different forms, as in a library, but within a single book, it is not likely to be problematic. However, the choice of descriptors and the controlling of the learner's queries will need special attention. The relative standardisation of terms that could be expected in an industrial context may not exist in instruction. A query such as 'find out costs of advertising all products in the London area in 1968' should be unambiguous to the system operator in an industrial company, since he will have defined all the system terms previously. In this respect, an industrial information system is a closed-loop system, with the same people constructing and making use of the system. In instruction, the designer and user are different, and so the designer must take care to try and anticipate the user's needs, if necessary through try-out experiments.
For this reason, the main emphasis in the following sections will be on devices which control the use of descriptors, and show them in relation to each other.

3.1 Retrieval Devices in Text Materials

Few, if any, text materials have no retrieval devices at all. Even spatial divisions in the layout of the text can be seen as descriptors, for they may imply divisions between semantic units. In scanning a text bereft of any retrieval devices, the eye would be passing over an undifferentiated mass of words, without any variations, such as indentations for paragraphs, headings or other indications of what the text contained.

There are six types of devices normally found. The first three of these occur in the text itself, and the other three are outside the text, either before it or after it.

a) Headings, glosses and key-words
b) Cross-References
c) Format
d) Table of Contents
e) Index
f) Introduction

The title of the document gives access to the document as a whole, rather than to parts of it, and is a retrieval device where there is a collection of documents; here,
however, the subject is retrieval within documents. Descriptions of these devices as they are typically found now follow. Some examples of these devices are given in chapter seven.

3.2 Headings, Glosses and Key-words.

Headings occur in between paragraphs and sections and at the beginnings of chapters; they can also occur in the margins, particularly at the tops of pages. In the latter case, they are sometimes chapter or even document headings (title), though they can also refer to the content of the page on which they are placed. Headings can vary in size and type according to their importance. Their main use is in quick scanning of the text itself, or referring backwards and forwards. This quick scanning can occur as a preliminary to more detailed reading, and retrospectively when the reader wants to find again a section he remembers. Headings are related to the information they refer to by their proximity. They depend for their effect on their size, on the space surrounding them, and their position.

Glosses are short descriptions of the text given in the side margin. Since they are more detailed than headings, they are useful for more local scanning within sections and chapters. They depend for their effect on their position, rather than size of print.

Key-words refer to all words within the body of the text which are distinguished by either type size, type form, colouring
or underlining. Although the primary purpose of these is to emphasise points as the text is being read, they can act as retrieval devices since the eye can pick them up on a quick scan. In the absence of research it cannot be said exactly how often or effectively this happens.

3.2 Cross-References

Cross-references are headings in the text which refer not to the information they are close to, but to related information in other parts of the text. They can be placed either in the body of the text, or in the margins, and consist of either an address where the descriptor is implied in the text, or else of a descriptor and an address. A reference to an entire chapter may be too imprecise to be useful, and more specific references can be given by using page or section numbers. Cross-referencing, like indexing, necessitates clearly-defined units of information in the text. This may be the page unit, or section units. Cross-references can refer forwards or backwards in the text, and may indicate information which is thought to be pre-requisite for the understanding of the part of the text which is being read, or else related in a more general way. The examples of retrieval devices in Chapter Seven contain two examples of cross-referencing.
3.4 Format

The format of the text allows the reader to divide the text into sections, thus switching between one part and another. This can be done by using spatial divisions, such as blank pages between chapters, spatial irregularities, like indentation, and colour, by using either single coloured pages as dividing pages or having whole sections on different coloured pages.

3.5 Table of Contents

The table of contents is found usually at the beginning of the text and lists the main chapter and section headings with the appropriate page or section numbers. This list is in order of sequence. The table of contents does not tell the reader anything more than comparable headings in the text itself, but it allows him to scan the headings without scanning the text as well. This is possible because a notation system is used which links the descriptors in the table with the relevant parts of the text. As a guide to sequence, the table is useful. It may be less useful as a guide to contents, since some tables of contents give only a few main chapter headings and no indication of what lies within each chapter. As can be seen in the next chapter, there are great variations in the amount of information given in these tables. Furthermore, the table of contents gives no indication of relations in the material which are not sequential; if, for example,
chapters 3 and 6 are closely related with chapters 4 and 5 as digressions, this will not be apparent from a sequential table. Another drawback to the table is that some descriptors in it may only be understood after the reader has studied the section they describe. The table of contents can be used in three ways: for a preliminary search of the contents, to gain an overview; as a device to refer back to while working in the material; and as a device for retrospective search and review.

3.6 Index

The index gives access to the text through selected key terms. The number of these and the depth of indexing varies. The terms are arranged in alphabetical order. This is a useful convention which does not however have any semantic importance. Although the reader may find words with similar roots near each other (e.g. psychology, psychotherapy), the order is more likely to be meaningless (French, frequency). Indexes can be divided into subject and author indexes.

As a retrieval device, the index depends on two things: a knowledge of the alphabet and a common understanding of terms. Although the first is usually present, the second is much less certain. Indexers can allow for mismatches in various ways; by having see and see also entries; these refer the reader to allowed and related terms respectively. They can also provide glossaries of important terms, which
minimise misunderstanding. As Langridge has pointed out, indexers need to know something about the subject of the book, and about the intended audience. Books intended for the general public are indexed for a wide audience; textbooks on the other hand, can be indexed much more specifically for the target audience. However, in textbooks, indexes are often absent or poorly done.

3.7 Introduction

The third retrieval device outside the text itself is the introduction, variously called the Foreword, Preface, Introduction or Overview. None of these terms is very exact, and may refer to any number or combination of the following:

a) Short account of the subject and scope of the book.
b) Description of the intended audience.
c) Personal and other reasons for writing the book.
d) Account of how the book was written.
e) Rationale for the organisation of the book.
f) Defence of the views expressed in the book.
g) Explanation of some terms in the book.
h) Acknowledgements.

Since the function of the introduction is so ill-defined, it would not be surprising if people tend to skip it, and get on with the text proper. Of the items listed above, only a few are really introducing the reader to the contents of the book; they are (a), (b), (e) and (g). An attempt will be made in a later section to define the functions of the
introduction more carefully, but a few of these can be indicated now. The introduction can act as an overview of the whole text, so that the reader can decide quickly if the text is the right one for him or not. It can also refer the reader directly to parts of the text, or together with the table of contents act as a switching device. The introduction can also point out relationships between parts of the text which are not apparent from the table of contents. Potentially then, the introduction is a powerful retrieval device, especially if it acts in concert with other devices. However, there is nothing in the literature and very little in practice (as exemplified in the next chapter) to suggest that these retrieval devices are planned as a whole, and seen to reinforce each other. In the next section, the description of the process of retrieval given in the first part of this chapter will be used as a framework for integrating all these devices into a coherent system.

4.1 Retrieval Devices and the Retrieval Process.

The retrieval devices listed in the last section will now be considered in the light of the process of information retrieval. Four stages in this process were identified, and each device can be assigned to one or more stages, as follows:
Stages in Retrieval

a) Query Formulation and Control
b) Scanning and Switching; Matching
c) Location of information
d) Evaluation of information retrieved

Retrieval Devices

a) Introduction
b) Table of contents, index, headings, format, cross-references
c) Headings; notation
d) ______________

It must be emphasised that this arrangement is a hypothetical one, and provides a framework for testing and design which can be explored; it is not a definite prescription for the planning of retrieval devices in every case. There are two main points to be noted. First, since retrieval is a process, the devices are arranged to correspond to parts of that process; this means they are being seen in concert rather than individually. It might be possible to have some devices take over the work of others, but there seems no good reason to suggest this. The relationships between the devices are suggested in Fig. 8.

Secondly, it will be noted that the fourth stage of the retrieval process, the evaluation of information, has no corresponding device. Retrieval systems do not usually provide means for the user to evaluate the information he gets. In an educational context, however, it seems possible that something more systematic might be done about this. It is not possible here to specify what means of evaluation might be provided, since this leads on to the extensive area of inquiry on feedback, knowledge of results and motivation. It seems possible however, that the learner's intuitive evaluation might be
Fig. 8. Suggested Organisation of Retrieval Devices in Text Materials.
aided by providing him with self-testing questions with the items of information he retrieves. He could thus have some objective feedback, however limited, on his own progress. The other possibility is that a tutor could help and advise him at various stages. A combination of frequent self-tests and periodic tutorial sessions might give the learner a better chance of evaluating his use of the system. This need for evaluation is not confined to users of retrieval systems; in source controlled systems as well, the learner may need feedback as a guide to his own learning strategies. So although it is a problem associated with the retrieval of information, it is not exclusive to it.

The devices will now be examined in order.

4.2 Query Formulation and Control

The functions of the introduction can be divided into two parts: stimulating the learner to formulate queries and controlling those queries. The first can be attempted in two ways: 1) by describing the salient points in the material in the form of a general overview; this may arouse the learner's interest in the book as a whole, or in particular sections of it; and 2) by deliberately trying to suggest links between the learner's previous experience and the new material contained in the book. This implies that the writer knows a good deal about his intended audience, and he could use Mager's human resource technique to discover how students approach the new subject. He could then provide
entries into the material for them. Taking Mager's electronic's course as an example, if the writer knew that students approached the subject through concrete elements like vacuum tubes and radio sets, he could highlight this part of the text in the introduction, even if it were not considered an important part of the text as a whole. The learner should feel that the writer is coming to meet him at least half-way, in trying to foresee his interests and difficulties. The extent to which this can be done with textbooks written for a wide audience is doubtful; the interests of learners are apt to diverge too widely for the writer to be able to select any in particular. If this is the case, there are two possible solutions. The first is to create textbooks for a more specific audience. This is already the case with programmed texts, which specify entry behaviors and the kinds of populations they have been tested on. There is no reason apart from an economic one, why textbooks should try to be all things to all people. As regards the cost, it might be cheaper, as well as more effective, to produce smaller and more flexible modules of materials, which could be used in a variety of combinations. The other solution is to create different retrieval systems for the same book, which would cater for the needs of particular groups. These could be produced either centrally or locally. Essential to this idea is the recognition that any retrieval system involves a selection from the total information. If needs differ, the selection can differ too.

A rudimentary form of this exists when tutors specify particular
pages of a book in a reading list. There seems no reason why this principle should not be extended to cover other devices as well.

In addition to stimulating the learner to formulate queries, and search for information, the introduction must also control these queries in certain respects. First, the learner must be sure that he has a suitable book. If the book is not on the right subject, or not intended to be used by this particular learner, then he should be made aware of the fact as soon as possible. Thus he must be given a clear account of the scope of the book, and the intended users. The former can be the same account as used to stimulate interest; the latter may contain a list of prerequisite skills. Books on psychology, for example, might assume a certain knowledge of statistics on the part of the reader. This should be made clear at the outset.

In addition to controlling the query which retrieves the book as a whole, the introduction should also control queries within the book. This means controlling the language of the queries. To some extent, the language of the introduction will already be indicating terminological norms. But a planned effort to facilitate the formulation of queries in the terms used in the book may need to be made in some cases. As Abercrombie has shown, even an apparently simple word like 'normal' is apt to signify different things to different people. The introduction should therefore control the query language in two ways:
1) by glossing and defining the main descriptors used in the table of contents, and 2) by anticipating special difficulties which may arise from differences between the user's descriptors and the system language. A table of contents which cannot be understood until the whole book has been read is only of retrospective use. In the second case, a reader who does not realise that a term he habitually uses has been subsumed or replaced by another one, will be frustrated in his attempts to use the index and the table of contents. Detailed glossing of many terms can be done in the text itself, but the main descriptors should be glossed before the learner begins to scan the descriptors.

The introduction has been assigned to an overall stimulating and controlling role. It should contain the following elements:

1) An overview of the text; this should both arouse the interest of the learner, and allow him to decide if it deals with the area he wants.

2) An indication of the intended audience, and their prerequisite skills; this controls the initial choice of the book as a whole.

3) Deliberate attempts to link the information to existing knowledge and experience; this might help the user to find his way into the material.

4) Glossing of unfamiliar descriptors, and anticipation of difficulties with other descriptors.
The introduction might also contain information about how to use the book, both from the point of view of retrieval and of study in general. The other things normally found in introductions could be placed elsewhere, in a section headed 'acknowledgements'.

4.3 Scanning, Switching and Matching

The second stage of the retrieval process involves scanning of descriptors and switching between them. During this, the process of matching the user's needs with the information in the system continues.

The function of glossing the key descriptors was assigned to the introduction. It was pointed out earlier, however, that the glossing of descriptors in isolation does not solve the problem of displaying relationships between them. This can only be done by arranging them in some order which shows the relationships. Two kinds of order will be considered here: the first is the familiar table of contents; the second is a new device, called the structural table.

The table of contents, as noted above, sometimes tells the reader more about the sequence than the content. It will therefore be referred to in future as the Sequence Table, and its functions will be defined as above:

1) To provide the reader with a clear idea of the sequence of content in the text.

2) To give the reader, in moderate detail, a description of the contents.
The first of these functions allows the reader to scan the sequence of the text without having to scan the text itself. He can thus gain some understanding of the 'logic' of the sequence, and whether it is likely to suit him or not. The rationale of this logic can be spelled out in more detail if necessary in a short explanation attached to the table. This could concentrate on making sequential links in the text. The second function is difficult to define accurately. There are certain limits, both upper and lower, to the amount of information given in the Sequence Table. If the information is no more detailed than is given in the introduction, it is redundant, apart from linking this to pages, and putting it in sequence. If the table is too detailed, a clear idea of the sequence may be obscured. In this case, it seems more useful to have subsidiary tables at the beginning of each chapter, and a general table at the beginning. The descriptors used in the table need to be genuinely descriptive; gnomic chapter headings may be satisfying to the writer, but convey little to the reader.

A second possible method of ordering the descriptors is in a table which shows the structure of the text, rather than the sequence. This could be in two-dimensional diagrammatic form, and would attempt to show relationships not apparent from the linear sequence. Since this appears to be a new idea, it is developed in more detail in Chapter Eight, but the basis of it can be explained here.
The notion of sequence has both a physical and a mental aspect. The physical sequence is that which is produced by proceeding from one page to the next, in the conventional order. There is of course no necessity to handle the book in this way, and languages, like Arabic, which are written from left to right, necessitate the reverse order. This physical convention is an expression of a mental assumption: that the semantic events which follow from adopting such a pattern have some 'logic' to them. Thus Mager discusses the notion of 'logical' sequencing. This notion again needs to be divided into two aspects: 'logical', used to mean discernible semantic relationships, and 'logical' used to mean the optimum learning relationships. In the first case, the author is appealing to general rules of rational discourse to provide a basis for sequencing. Thus it could be argued that history texts should be sequenced chronologically. On the other hand, a writer using 'logical' in the second sense might reply that the most logical sequence is one which starts with a general outline, and proceeds in increasing detail. This argument is based on the assumption that people learn best by subsuming fact and detail within general frameworks. The writer of a geography text might argue that the logical course is to study the most important countries first, and then proceed to smaller ones. A critic might argue that the learner should start with those countries, large or small, which are nearest his own experience and proceed to more remote areas.
Similarly in connection with the notion of structure, two aspects of the word 'logical' can be distinguished. The first indicates an attempt to identify all kinds of relationships in materials which exemplify basic rational concepts, such as causality, chronology, proximity, generic and specific relationships. Farr's work on relational indexing can be seen in this light. Logical structure in the second sense refers to all possible learning paths in the material. Different learners may produce different critical paths in an analysis of a task procedure and the best path to follow may vary from one learner to another.

There seems therefore to be two ways of analysing structure in material. The first involves having people discern the main relationships in the material, and displaying these in diagrammatic form. The second analysis would involve discovering the various paths used by learners in tackling the material and presenting these all together in diagrammatic form. Research could show if the two displays were similar or not. With regard to the retrieval process, the first type of analysis gives the learner control over his sequencing, since by providing a static display of relationships, it does not predicate any one path through them. The second analysis is a sophisticated form of branching sequence; a dynamic display of learning paths. It would seem more useful to put information about branching with the sequence table, since that table gives the norm from which branching can occur.
This might take the form of advice about skipping material, or retracing. The structural table could then be devoted to a display of relationships which are neutral from the learning point of view. This could be seen as an extension, in a different format, of certain indicators which already exist in indexes, notably for generic and specific relationships, and related terms. The relationships can be indicated more exactly by using a combination of diagrammatic conventions (e.g. lines and arrows) and words. This latter approach has been used in chapter eight, where the aim has been to produce a display of the main "logical" relationships in the material which the reader can then pursue in the best 'psycho-logical' order for himself.

A third way of ordering descriptors makes use of a convention which reflects neither principles of learning, nor semantic relationships. This is the index. The index is a random list of unrelated descriptors which are arranged in an order which has no meaning, but which everybody knows and can follow. Within this list, limited relationships are specified by the use of generic-specific and related term indicators. The index also indicates the intersection of terms, as in the following entry:

Television

- in furkex education
- in higher education
- in secondary education
The difference between the index and the other sets of descriptors is that whereas in the table of contents and structural table the descriptors are arranged in a meaningful relation to each other, in the index there is no meaningful relation. On the other hand, there can be many more descriptors. This suggests that the role of the index is to provide detailed entries into the text through the use of numerous, isolated descriptors. If the various devices are arranged in order according to the number of descriptors they use as a proportion of the total text, the order should be as follows:

1) Introduction to the text (a few main descriptors)
2) Sequence and structural tables (rather more descriptors than (1))
3) Index (numerous descriptors)

If the index is not more detailed than either the sequence or structural tables, then much of its information is redundant, for the latter can be used as crude indexes. There seems no reason why the index should be separated from other retrieval devices and put at the end of the book. If anything, this gives the impression that it is an afterthought. Properly used, in conjunction with other retrieval devices, it can provide an accurate and detailed method of manipulating information. As with the other devices, the index should be constructed with some foreknowledge, gained empirically or through careful judgement, of the needs of the users.
There is little to be said about the use of headings and format as retrieval devices. Care should be taken that headings are large enough to be detected easily, and not so numerous as to break up the flow for those who are reading the text as a sequence. Surprisingly little use seems to be made of really large headings which meet the eye on a quick overall scan. Examples of the use of print of this size abound in advertising, but are rare in textbooks. Nevertheless, they allow the reader to get an overall impression of the main divisions of the book. Headings in the text should be consistent as far as possible with the headings used elsewhere, in the sequence table etc. The use of format to emphasize semantic units in the text is often rather poorly done. Used boldly and sparingly, such devices as blank pages, coloured pages and irregular format, may help the reader to get a sense of the overall structure. The examples given in the next chapter show on the whole a conservative approach to the use of headings and format. The examples, or rather lack of them, of cross-referencing given in the next chapter suggest that this is a device which could be used more imaginatively. The cross-reference is an in-text device (i.e. used while the learner is in the process of reading the text, rather than before or after) and can provide accurate referencing for information which is related in any way to the part of the text it is beside. A large number of such references would build up a network within the text which might be similar to the network shown in a structural table. Some empirical basis for the references could
be had by observing movements back and forwards in the text of readers of trial editions, and asking them why they felt they had to refer backwards and forwards at a particular point. If necessary, a cross-reference could then be entered at that point.

4.6 Location of Information

The third stage of retrieval begins when the process of scanning and switching using the above devices has finished. In this stage, the reader works from the chosen descriptors, through a notation system, to the text itself. Where descriptors are headings in the text, this stage is eliminated, for the headings are directly above the material they refer to.

The system of page numbering is the most common form of addressing. From the sequence table, it is a simple matter to see that the third chapter starts on page 76 and then to find that page. Term entries in the index may not be so easy to locate, since the text referred to may not start or finish at the beginning or end of the page. This can be used as an argument in favour of using a notation system for sections, rather than pages.

5. Conclusion

A framework, based on an analysis of the stages of the retrieval process, has now been suggested for the arrangement of retrieval devices in text materials. This assigns the function of query stimulation and control to the introduction
the sequence table, structural table and index are seen as the main devices for scanning and switching, and headings in the text can also be used for this. The system is completed by the existence of a notation system referring either to pages or sections. The main concern in this chapter has been to define the devices as a system, and determine their function in relation to each other, so that they can complement but do not overlap. This has been the main problem in defining the roles of the sequence table, the structural table and the index. The first facilitates the choice of learning sequences; the second gives a display, neutral from the point of view of learning principles, of semantic relationships in the material; while the third provides detailed access through numerous descriptors.

This analysis provides a framework for designing and testing materials as stores of information. Suggestions for experimental work are made in the final chapter. The above analysis is not meant to be a prescription to be followed in all cases; rather it is an exploration of possibilities. Two of these possibilities are followed up in more detail: Chapter Eight is devoted to further discussion and examples of structural tables; Chapter Nine investigates the possibilities of reordering the actual text, since one of the results of a more coherent retrieval system is more freedom in the arrangement of the actual text.

The next chapter gives examples of retrieval devices from various texts, and provides reference material for some of the points made in this chapter.
REFERENCES TO CHAPTER SIX

1. LUMSDAINE, A.A., see Chapter 3, reference 3.
2. BURNS, R.W., and BROOKS, G.D., see Chapter 3, reference 10.
5. MAGER, R.F., art. cit.
7. JOLLEY, J.L., Data Study (London, 1968), p. 82.
8. MAGER, R.F., art. cit.
12. FOSKETT, D.J., art. cit.
13. VICKERY, B.C., ed. cit.
15. Ibid.


22. FARRADANE, J., 'Relational Indexing and Classification in the Light of Recent Experimental Work in Psychology' in *Information Storage and Retrieval*, vol. 1, 1963, pp. 5-11.
CHAPTER SEVEN

SOME EXAMPLES OF RETRIEVAL DEVICES

1.1 Introduction
1.2 Criteria for Selection
1.3 Selection
1.4 Method of Analysis
1.5 A List of Texts Considered
1.6 Table Showing Retrieval Devices in Each Text
1.7 List of Illustrations from Texts

2.1 Introductions
2.2 Tables of Contents
2.3 Indexes
2.4 Headings in the Text
2.5 Cross-References
2.6 Format
2.7 Notation

3 General Comments
CHAPTER SEVEN

SOME EXAMPLES OF RETRIEVAL DEVICES

1.1 Introduction

The suggestions which were made in the last chapter regarding the design of retrieval devices in textbooks were derived from an analysis of the retrieval process, rather than an examination of existing devices. In this chapter, some examples of retrieval devices have been collected. The aim of this has not been to evaluate them; nor are they meant to be a representative sample of retrieval devices found in textbooks used by adults. The point of these examples is to provide some concrete references for the analysis in the last chapter, and to show some of the features of each device which might be explored further. The devices are described with reference to the functions assigned to them in the last chapter; this has meant that a number of critical comments have been made in terms of these functions. However, it should be remembered that the functions suggested in Chapter Six have not been tested out in practice, and while a number of features of some of the devices examined here seem clearly inadequate, this must remain a limited judgment until the devices are put to the test experimentally. The devices are examined in the order followed in the final sections of Chapter Six:
The examination is preceded by a list of texts used, and a table showing which retrieval devices are present in each text. One difficulty lay in deciding whether to examine all the devices in each book together, or to select similar devices from all the books, and compare them. The second method has been chosen, since it gives a clearer idea of the range of possibilities in each device. The overall distribution of devices in each book can be gathered from the general table provided; this is not entirely satisfactory, but since none of the books gives evidence of the conscious planning of retrieval devices in concert, it seems more useful to concentrate on classes of devices. Some general comments on the planning of devices have been made at the end.

1.2 Criteria for Selection

Certain limits were placed on the texts that could be chosen. They were restricted to a) books that are designed for study rather than general reading, and b) books that might be used by adults. The first distinction is hard to
draw in some cases, and has been waived in cases where unusual devices occur. The second criterion includes books used in higher education, but excludes books designed for school children. Since the books do not constitute a sample, it was not felt necessary to restrict the choice to books currently being used by adults in formal classes.

The books were chosen to include the following: a) a broad range of content, b) unusual retrieval devices or format, and c) textbooks and programmed texts. The first point has been well covered; the subjects of the books include literary criticism, Persian, computing, adult education, linguistics, history and graphic design. The second criterion has led to the inclusion of one book (McLuhan) which cannot be described as a textbook. This was done because the book has unusual design features. Programmed texts have been included in order to provide contrast to textbooks; in general, the impression has been gained that programmed texts have rather fewer retrieval devices than textbooks, although Markle shows that this is not necessarily the case.

1.3 Selection of Texts

Selection of texts proved difficult for several reasons. There appears to be no precedent for this kind of analysis, and therefore no procedures for selecting or obtaining texts. The main search was carried out informally over a year in libraries in Edinburgh and at the University of Sussex.
enquiries from six publishing houses brought little to light. It appears that few textbooks are consciously designed for use as information stores, apart from reference books, like dictionaries, bibliographies and encyclopedias. These do not attempt any continuity in the text, so there is not a dual function of sequence and store.

It is possible that reference books might provide useful ideas for the design of retrieval devices in textbooks, it was felt that the inclusion of reference books in general would widen the scope of the thesis unduly.

1.4 Method of Analysis

Initial scanning of texts showed whether they had any features of interest. About thirty texts were finally assembled, and studied in more detail. Finally, thirteen of these were selected, to which one more (Horn) was later added. It was felt that the number of books analysed should be small enough for the retrieval style of individual books to become evident in the analysis. Most books are referred to several times, for different devices, and it is hoped that the reader can get an overall picture of at least some of the books. If devices were selected from a large number of books, it would be difficult for the reader to grasp the style of individual books.

Devices from various books were grouped together and analysed. This process of analysis was intuitive, guided by
the framework which was worked out in the last chapter, and by comparisons between books which arose in the course of the investigation. Examples of each device have been described here and reproductions included where necessary. No previous examples of the analysis of retrieval devices in textbooks could be found, so the method used here was evolved in the course of the analysis.

A list of books analysed, and the devices present in each book, precedes the first section, in which introductions are examined and compared.

1.5 A list of Texts Considered:


### Table showing Retrieval Devices in each Text

<table>
<thead>
<tr>
<th>Authors</th>
<th>Introduction</th>
<th>Table of Contents</th>
<th>Index</th>
<th>Headings</th>
<th>Cross Reference</th>
<th>Notation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cambridge Consultants</td>
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<tr>
<td>Garland</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Gleason</td>
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<td>X</td>
<td>X</td>
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<tr>
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<tr>
<td>Horn</td>
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<tr>
<td>Jolley</td>
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<td>Lambton</td>
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<td>Meadow</td>
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<tr>
<td>Richards</td>
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<td>X</td>
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<tr>
<td>Whitworth</td>
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<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
1.7 List of Illustrations from Texts

For the sake of clarity, the figures in this chapter have been numbered separately from the figures in the rest of the thesis, and are listed here with their references, in the order and groups in which they come. In some cases, there are no page numbers in the text for reference.

Introductions
Fig.1. Gleason, H.A., p.iii.
Fig.2. Garland, A. p.6.

Tables of Contents
Fig.3. Whitworth, D., p.v.
Fig.4. Prosser, R.
Fig.5. Meadow, C.T., p.xi.
Fig.6. Jolley, J.L., p.5.
Fig.7. Horn, R., p.30.
Fig.8. Lambton, A.K.S., p.v.

Indexes.
Fig.9. Richards, I.A., pp.296-297.
Fig.10. Jolley, J.L., pp.246-247.
Fig.11. (author).
Fig.12. Ranganathan, S.R., pp.634-635.

Headings and Cross References
Fig.13. Cambridge Consultants.
Fig.14. Lambton, A.S., pp.20-21.
Fig.15. Markle, S.M., p.143.
Fig.16. Prosser, R., pp.106-107.
Fig.17. Good, J.M., p.132.
Fig.18. Horn, R., p.20.
Fig.19. Markle, S.M., p.56.
Fig.20. Richards, I.A., pp.114-115.

Format
Fig.21. Prosser, R., pp.148-149.
Fig.22. Whitworth, D., p.1.
Fig.23. McLuhan, M., pp.40-41.
Fig.24. Horn, R., p.54.
Fig.25. Horn, R., p.106.

Notation
Fig.26. Ranganathan, S.R., p.319.
Fig.27. Meadow, C.T., pp.278-79.

2.1 Introductions

In Chapter Six the introduction was assigned an overall stimulating and controlling role in relation to query formulation. It was suggested that it should include the following:

1) An overview of the text.
2) An indication of the intended audience.
3) Deliberate attempts to link the new information with the learner's previous knowledge.
4) Glossing of unfamiliar and important descriptors.

It was also noted that introductions, prefaces and forewords sometimes contain other and less relevant information.
An example of the latter occurs in Gleason's preface (see Fig. 1). The first page of this embarks on a broad description of the place of descriptive linguistics in academic studies. Although this is clearly written, it assumes a considerable knowledge of linguistics in a book which is called 'an introduction'. The preface goes on to a description of how the book came to be written, how it has been used, and ends with a list of acknowledgments. It might be argued that a preface is not the same as an introduction; but the difference is not clear from the books examined here, and if the reader does not read Gleason's preface, he must embark straight onto the text. Gleason's preface appears to be an introduction to the subject rather than to the book, and there is an important difference. Introductions to the latter should facilitate their use, rather than attempt to give wide-ranging discussions of the content.

At the other extreme, Cambridge Consultants have no introduction, only a pre-programme quiz, which ends with the words 'If you have answered all these questions, you already know what we shall teach in this programme'. This hardly seems an adequate introduction for those who do not know.

Whitworth has a section entitled 'To the reader':

This book sets out to give you a high-speed introduction to digital computers and to show you that this highly technical subject makes surprisingly simple overall sense.
Because we could assume only a lively intelligence and keen interest on the part of you, the reader, we start from scratch by introducing the idea of computers in business as if to a young person who is just beginning his career. Thereafter, the I.C.L. Series 1900 provides most of the examples and these first steps are seen mainly in terms of that specific computer.

Although the material is presented for quick, easy reading rather than hard study, you will want to hold on to the main points. To help you do so, the end of each section is a checkpoint at which you're invited to test yourself on that section's ten or so main points. In addition to this, occasionally an individual point presents an opportunity for you to write an answer.

When you've finished the course satisfactorily, you'll be ready — should you need to do so — to learn how to program a specific computer.

This is a mixture of genuine information, like the checkpoints at the end of each section, and rather vague sales talk. Describing the book as a 'high-speed introduction' to a 'highly technical subject' conveys very little concrete information either about the book or the subject. There is no mention of what happens if the student does not finish the course satisfactorily, or if his intelligence is rather less keen than they assume.

Jolley, in his introduction to Data Study makes a more systematic attempt to meet the reader: he states that his introduction 'sets the scene, and describes and layout and purpose of the book'. Although he describes the main divisions of the book, and provides a brief diagram of the subject area, he omits to mention the short but useful summaries at the end of each chapter. Like Gleason, he seems more concerned to introduce the subject than the book:
Dealing with information in large quantities is typical of mid-twentieth-century technology, like ergonomics, bioengineering, cybernetics, or operational research. It is a curious mixture of the abstract and the concrete, jostling binary subcoding against research into the purchase of washing machines, the laws of Boolean algebra against the selection of personnel for job safety courses, and the pattern of meaning against the creation of private indexes of stamps, colour slides, plants, recipes, or ancestors.

If the reader already knows what binary subcoding and Boolean algebra are, he need hardly read the book. It seems that Jooley is deliberately using terms which he knows his readers will not understand,

It is difficult to introduce the book without to some extent introducing the subject, and some of its difficulties. Prosser, for example, after a clear account of the layout of the book and the intended audience, embarks on a discussion of terms.

Throughout this book, a major problem which I have faced has been concerned with terminology. I am not satisfied with the term "Adult Education" and have toyed with the possibility of using such other contemporary terms as "Life-long-education" or "Continuing Education".

The difficulty is real enough, but unless the scope of each term is discussed in detail, there is little point in embarking on such distinctions in the introduction. It may be that authors have one eye on the ordinary reader and one eye on their peers and critics in the introduction; this would explain why points of some academic nicety like the above are interpolated into otherwise simple introductions.
Richards' introduction, although lacking in most of the elements set out in the last chapter as desirable, shows an awareness of difficulties arising from the 'serial form of the exposition'. Comparing his book to a loom on which he intends to re-weave some of the ravelled strands of our civilisation, he comments:

The elaborations and expansions which suggest themselves have been constantly cut short at the point at which I thought that the reader would be able to see for himself how they would continue. The danger of this procedure, which otherwise has great advantages both for him and for me, is that the different parts of a connected account such as this, mutually illumine one another: The writer who has, or should have, the whole position in his mind throughout, may overlook sources of obscurity for the reader, due to the serial form of the exposition. This I have endeavoured to prevent by means of numerous cross-references, forwards and backwards.

The cross-references, which tend to be to whole chapters, are probably too imprecise to be useful, but the implications are interesting. Richards perceives a mismatch between the many strands of his argument and the serial form of the text.

Garland (see Fig. 2) assumes that readers tend to skip the introduction and uses an unusual format to attract the readers' attention. Another way to do this is to rename the introduction; Markle has two sections entitled 'Preface' and 'To the Student'. In the second, she gives advice about working through the programme, regarding responses, format and timing. Under the heading of 'branching', she writes:
Language is one of the most important and characteristic forms of human behavior. It has, accordingly, always had a place in the academic world. In recent years, however, its position has changed greatly: at one time the study of language was almost entirely restricted to specific languages, primarily those of Western Europe and classical antiquity; over the last few generations, a much broader consideration of language has taken a place at the side of the study of individual languages.

As each of the social sciences has developed, it has encountered language problems within its domain. Psychology, sociology, and anthropology have each investigated language both as a type of human activity and as a system interacting with personality, society, or culture. Language has intruded even upon technological problems, and engineers have found themselves driven to basic research on human speech. Today, as a result, we have well-established techniques for the study of language from a number of different points of view. Each of these techniques supplements all the others in contributing to theoretical knowledge and the practical problems of the day.

One approach has, however, received little attention until very recently: descriptive linguistics, the discipline which studies languages in terms of their internal structures. It differs from the other approaches in that it focuses its attention on different facets of human speech. The common general subject matter and its special competence to handle certain types of problems bring it into important relationships with many other disciplines.

Concurrent with the broadening of interest in language, there has been a fundamental change in the teaching of specific languages. Tongues which a past generation would have thought unworthy of serious attention are now taught in regularly scheduled classes. The variety of linguistic structures which must be dealt with has increased markedly, and the need has arisen for a broader perspective. Descriptive linguistics has thus become an essential concomitant to the newer language program.
People often skip introductions in books of this kind, so this one is printed in a larger size of type in the hope that it will not suffer such a fate. I want to persuade you to read it before you get into any particular section; otherwise you may be puzzled by some of the things that have been included. You may wonder, for example what a description of the Universal Decimal Classification system is doing in a book on graphics. And how did that stuff about topological graphs get in? And whom is the author kidding with his ‘telephone as a tool for the graphic designer’?

Everyone is the prisoner of his own preconceptions and those concerning his own abilities and working potential are frequently the most constricting ones of all.

Why, at a time when communication systems of all kinds are increasing in scope and complexity, we should feel bound by any narrow definition of the scope of graphic
Since students differ, the program has been designed as far as possible to enable you to schedule your own reviews as well as to take different tracks at different points. You will find summaries at the end of sections and chapters, a Glossary in the back, and an Index to assist you in locating something you want to look at again. Don't overlook the Table of Contents as a tracking device. Directions are given in the text where branches occur, letting you get a hint if you need it, skip something you're not interested in, or review if you wish.

Although she limits the use of the index to a retrospective one, Markle at least gives some directions on how to use the retrieval devices. Together with the Preface, this section gives a rounded introduction to the subject of programming and to the book, and suggests that the absence of introductions in other programmed texts is accidental rather than anything to do with the techniques of programming.

2.2 Tables of Contents

In Chapter Six, the functions of the table of contents were defined as follows:

a. To provide the reader with a clear idea of the sequence of contents in the text;

b. To give the reader, in moderate detail, a description of the contents.

Several other points were noted: the descriptors used in the table of contents should be neither too enigmatic nor too technical for the beginning reader, and some of them could be glossed in the introduction if necessary. Secondly, a distinction
was drawn between displays of paths (in the sequence table) and displays of relationships (in the structural table). It was suggested that the table of contents, or sequence table, might show alternative paths and branches from the main sequence.

Of the texts examined, two, Cambridge Consultants and McLuhan, had no table of contents. In this case the reader has to scan the entire text to see what sequence has been used. In the other texts, the tables of contents range from the very brief to the very detailed. An example of the first occurs in Whitworth (see Fig. 3) where there are four headings for 147 pages of text, approximately one for every thirty-seven pages of text. The explanations below the headings add little to this. Jolley, too, has a brief table of contents with 13 headings for 240 pages, giving a proportion of about 1 to 18. Prosser (see Fig. 4) and Richards both have a proportion of about 1 to 8, but the most detailed is Meadow (see Fig. 5) who has 167 headings for 289 pages of text; over one for every two pages. Such proportions do not mean very much in themselves, but they do show a wide range in the amount of detail given in the table of contents. In the absence of any firm evidence, one can only guess that entries as sparse as Whitworth's are too meagre to be useful, and that when they are as detailed as Meadow's they may begin to obscure the overall sequence. One possible way out of this difficulty is to
have an overall table of contents at the beginning, and
more detailed tables at the beginning of each chapter. This
might provide detail without obscuring the basic sequence.

Another important aspect of the table of contents is
the ease with which its terms can be understood. If the
reader does not understand a descriptor or heading until he
has read the section referred to, the table can only be used
retrospectively, instead of being useful before and during
the reading. Of the above mentioned tables, Prosser's seems
free from obscurity. (This is of course a subjective judgment,
and the tables need to be tested for comprehension on samples
of the intended audience). Whitworth's explanations (see Fig.3)
help with potentially obscure terms like 'peripherals' and
'processors', but could be extended and made clearer.
Richards' table contains a number of obscure headings: 'The
Phantom Aesthetic State'; 'Tolstoy's infection Theory'.
Richards adds that terms used in special senses are specially
defined and can be consulted in the index.

Some of Jolley's entries convey little at first sight:
'Questions and Vehicles', 'Many Disguises' and 'Relations'.
In fact the whole of Jolley's table (see Fig.6) is rather
cryptic. This is to some extent offset by a short explanation
at the beginning of each chapter, for example:

7 The behaviour of subcodes
discusses binary and graphic subcodes
both commutative and serial, shows the
genesis of crossovers, and generally
prepares for a study of directly
represented meanings

7
This may not convey much more to the uninitiated reader. It appears from the index that some of these terms have been used, and presumably explained, before: graphic subcodes, crossovers, and the term 'commutative'. 'Binary subcodes' and 'directly represented meanings' have not occurred before. In a case like this, where the understanding of descriptors depends on reading a previous section, it might be useful to indicate the prerequisite parts, by giving page references, as follows:

7 The behaviour of subcodes

discusses binary and graphic subcodes, both commutative and serial, shows the genesis of crossovers, and generally prepares for a study of directly represented meanings 7

subcodes, 112-13
graphic codes, 110-11
commutative subcodes, 78
crossovers, 112-13

Chapter 7 starts on page 120, so most of these references are recent, and could be found easily. The fact that the commutative subcodes reference appears to pick up a thread from forty pages before, suggests that small retrospective tables like these, placed at the main divisions in the text, might help the reader to orientate himself. A somewhat similar system of indicating prerequisites has been suggested by Horn (see Fig. 7) on a page level. The related pages are given at the foot of the page in the example shown. It may be that to attempt such linking at a detailed, page level is making the network too complicated and links at sections or chapter level might be adequate.
Section 1 contains nothing about computer hardware. Instead, it introduces the environment in which modern digital computers mostly operate.

If you have some familiarity with business practice, or if you have gathered from general sources some idea of how computers perform business data processing tasks, you may want to skip Section 1.

In Section 2, you are still ‘external’, as it were, to the computer proper. There you consider a variety of input and output media with particular reference to their speed of working.

Thus, you will see what sort of work a digital computer does and at what sort of pace.

In Sections 3 and 4, you will see how the computer does its processing and how the programmer commands its performance.
A third important aspect of the table of contents is the degree of consistency between the headings and numbers used in the table and in the texts: thus the reader expects to find the same chapter heading in the table and the text, with the same page reference. Most texts appear to have taken this precaution. However, in Whitworth's second section, 'Peripherals', there are a number of headings in the text of the same size and colour as the section heading. These are not entered in the table of contents. In Lambton (see Fig.9), the headings within the lessons in the content table have no corresponding headings in the text. Each topic, or heading, starts at a numbered section, but it is the page number, and not this section number, which is given in the table. The reader cannot thus refer directly to the text from one of the headings in the table.

2.3 Indexes

In Chapter Six, it was suggested that the function of indexes was to give detailed entry into the text, through the use of numerous descriptors. These descriptors are not arranged in any meaningful order (i.e. according to sequence or structure), but according to the alphabetical convention. They are usually more numerous and detailed than the descriptors used in the table of contents or the introduction.

Six of the texts under consideration have no index. Markle's text has an index added in the second edition.
The indexes all occur at the end of the books though there seems no reason why they should not be placed at the beginning. Important aspects of the index are the depth of indexing, i.e. the amount of detail and number of entries; the extent to which the index shows the interrelation or intersection of terms, as well as showing terms in isolation; the type of index, whether linear or co-ordinate; the layout and typography; and the intention of the indexer to index for a general audience, or for a specific one with specific needs.

All the indexes in the textbooks being examined came at the end of the text. The fact that indexes are habitually placed after the text may give the impression that they are only to be used retrospectively, for reference after the main reading. If placed at the beginning, they might present themselves to readers more obviously as retrieval devices for use before, during and after reading.

The depth of indexing varies considerably. Markle has about 100 entries for 300 pages, a ratio of one to every three pages, whereas Jolley has approximately 350 entries for 240 pages, a ratio of about one to every two-thirds of a page. More important than this crude ratio, is the style of indexing. Richards (see Fig.9) makes no attempt to show where terms intersect, whereas Jolley (see Fig.10) gives detailed subheadings for each entry showing the intersections of the entry term with other important terms. For example, under the entry 'Emotive Language', Richards gives the following:
In contrast, Jolley enters terms with each page reference:

Hierarchies: a basis for classification 79; and codewords 79-80, 128; and dependence 98; and collapse 99; and codewords for numbers 103-4; shown in data field 105-6; and faceted classifications 150-1; and flat-tray visible cards 186.

The total effect of this difference is to give Jolley's index the appearance of being more detailed and representative of the relationships between the main terms in the text (see Figs. 9, 10). It is difficult to see how a reader can use entries of the type Richards gives, unless he is engaged in a blanket search for all instances of the term 'emotive language'; a mere list of page numbers is not likely to encourage him to use the index for more specific purposes. On the other hand, it is possible that an index as detailed as Jolley's is in itself off-putting, and that some more amenable way of presenting this information should be found. Jolley mentions one possible way: a coordinate index. No examples of coordinate or matrix indexes could be found in textbooks. The examples given here are artificial in that they have not been used in actual texts. However, the bibliography on Educational Technology which this author is preparing will use several examples of this kind of index. The following examples are based on these.
The advantage of a co-ordinate index is that it allows the indexer and the reader to combine terms, showing where they intersect more clearly than is possible in a conventional linear index of the types exemplified above. The advantages of combining terms are most obvious when there are well-defined sets or arrays of terms. In the example given here (see Fig. 11) the sets are of subject and level of education. Thus the terms in each set are mutually exclusive e.g. Art, Biology, Botany. The numbers in the relevant boxes refer to pages or sections in the text, so that the reader searching for biology at university level would turn to page 240. It is possible, by using several of these grids, to show other intersections for the same set or array. Thus a second grid might have the subject along the vertical axis, and teaching method (e.g. lectures, discussions, experiments) along the horizontal axis, and a third might have subject and medium along the two axes. Thus the reader would be able to relate his particular subject to level of education, teaching method and medium.

Grids of this sort in history or social studies texts might provide intersections for period and country, or country and topic, or period and topic. Thus the reader could find specific references for urbanisation (a topic) in various countries, in various periods. In literature, the intersection might be of art form (e.g. plays, poetry, novel, etc.) with period or country, or of particular literary themes (e.g. nature, city life, love) with particular writers. Even where such
tables are not provided with the text, the teacher or tutor could construct them for use of his class, for either an individual text or a collection of texts.

A further important aspect of indexes is the way they are printed and laid out. Richards' index (see Fig.9) is set out in a type size much smaller than that of the text, with no attempt to distinguish between people and subjects by the use of italics or heavy type; in general, it is not the kind of index which is immediately attractive. Jolley gives a brief introduction to his index:

Each main heading is followed by a brief note of what is said on the page concerned, and then follows page references. Synonyms have been given a brief set of references of their own. The main headings may be thought of as a list of keywords, with the pages — the items — noted against them. Each item is given a phrase which contains other applicable keywords, which in most cases appear as main headings in their turn.

Jolley has made an attempt to explain how his index has been constructed and how it works. However, his index is also printed in very small type, and although the use of large type would make the index rather long and unwieldy, type as small as that used in the two indexes here, may be a real disincentive to use.

Ranganathan's index has several unusual features. In the first place it indexes to sections (see Fig.12) rather than pages. Thus the reference for Schopenhauer is AB6, which refers to part A, chapter AB, and section 6 in that chapter, which is on page 23. The section notation is given at the
top of the page in the text, and the page number at the bottom. The advantage of indexing to sections is that the reference is more specific than a page reference, with a definite beginning and ending. This of course necessitates organising the text in sections short enough to be indexed in this way.

The second notable feature of this index is its specification of some relationships between terms, and facets of terms. These are abbreviated as follows:

- **def** = defined
- **desc** = described
- **irt** = in relation to
- **r by** = referred by
- **r in** = referred in
- **rirt** = referred in relation to

An example of this in use is the following entry again from Ranganathan:

**Rigidly faceted classification**

```
    desc  CX
    irt  Autonomy to classifier SC3
```

It might also be possible to specify other kinds of relationships such as **generic to**, **specific to** or **caused by**, and other facets, such as **criticisms of**, or **history of**.

A final feature of any index is the extent to which it is aimed at a general or specific audience of readers. Langridge suggests that an audience specification is an important factor for the indexer:
...The second is knowledge of the uses to which an index may be put. It includes an understanding of the different types of reader, laymen and professional, both in relation to the subject matter of the book and in relation to the use of books and libraries. It includes awareness of the different types of search that can be made: by the reader who wants to refer to a passage he remembers; by the private owner who wants to refer to a passage he remembers; by the private owner who wants specific information from the only book he owns on a subject; by the researcher in a library, collecting material from many books; by the prospective buyer (or even reviewer) who wants a more detailed guide to the book's contents than is provided by the contents list; by the bibliographer who eagerly seeks every single mention of his subject. We do not know nearly enough about these various approaches but at least it is part of the professional indexer's job to know as much as possible.

Langridge is discussing indexing for general readers. In an educational context, the relevant information for the indexer would include the target population of learners, their likely previous knowledge, the degree to which they will already understand the descriptors he is using, and the ways they will approach the subject. Detailed information on all these things would give the indexer a clear guide as to what to index, and in what depth. It is also possible that several indexes could be constructed for the same text, for different users, which would reflect the needs of the groups in question. There is no evidence, either in the indexes themselves or the comments accompanying them, that any of the indexes in these texts have been constructed with a specific audience in mind.
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Direct range: part of semantic continuum above generic point 115, 117.

Direct terms: noted 110.

Disjunction: and arrays 62; and the total exclusion 82, 89; and classified schedules 208-9; examples of an intransitive intransitive symmetric irrereflexive relation 216.

Display: composed of data units 20, 24; forms a data field when fitted into a net of terms 24-5.

Distances: in the holotheme; contrasted with putting processes; a type of occurrence 162.

Expansion (binomial); and proportions of presence and absence 135-6.

Expansion (data field): as reverse of collapse; of units into runs and subfields 21.

Expectation (chance, likelihood); and density of punching on feature cards 58.

Extensions: of the data field, transverse to each other 16; and complementation 169; examples of an intransitive intransitive symmetric irreflexive relation 216.

Display: composed of data units 20, 24; forms a data field when fitted into a net of terms 24-5.

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Expansion (binomial); and proportions of presence and absence 135-6.

Expansion (data field): as reverse of collapse; of units into runs and subfields 21.
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<td>French</td>
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Fig. II. Co-ordinate Index (author).
Diagram 13: Terminology GA01
Organisation for XK
close classification JH31
Scheme of
assortment
def CD6
irt Scheme of classes CL2
classes CL
School of
Librarianship
irt Five laws DB05
r y>Sayers AA1
irt Dorking Cont AD21
Library Science
irt Sorting box CK8
Uttar AD3
Schopenhauer AB6
Sciences XC8
Scientific
approach SS1
Information Conference
London KB4
Washington AD22
method
and five laws DB05
Spiral of XC2
SC ir1
Almost-Enumerative classif CU2
Automatic conformity EQ35
Extrapolation LF32
Interpolation in array LD63
Its notation HC915
Radiation GC52
Relatively JD4
Secondary
collection WB62
dimension QA72
Second law DB2
Sector
device HC72
notation XF33
Capacity of HD4
def HC74
notational system HE3
table HD4
Sectorising digit LC3
irt Impartiality DD2
See also Empty digit
Sectors in zone HC752
Seeds for Prolegomena AD
See XG25
Seetharama HA76
Seminal
bottom RA4
ideas RA5
level RA
mnemonics KE
Seminar on
classification XK7
research in social science WC2
Separability of planes MA4
Sequel UA47
Sequence
Character of CK51
Filiatory See Filiatory—
Helpful See Helpful—
irt Classification GA32
of boxes CK5
of component in class numb VC5
of entities CK5
of facets
Harmonius XI1
irt Impartiality DD1
of subjects and Law
2 DB22
3 DB3
Serial TC22
Service
library DH4
organs of a house RL72
Shades in synonym MB13
Shakespeare irt
Impersonation RE2
Minor authors GE3
Shakespearian scholarship DC2
Shape of number HC20
Shop keeper XB2
Short notation SM1
Shortness in book number UD11
Shortening of class number DG35
Sidhas CJ
Single inverted comma HA75
Sita ME3
Sluggishness of language MB11
Social
changes XF5
entity RL8
necessity of five laws DB04
Sciences
irt Postulate of tool facet RD4
Observation in XD54
Research in WC2
Subject bundles in TE6
2.4 Headings in the Text

Headings in the text provide a means for the reader to scan the text itself quickly, to orientate himself on the main divisions in it, and to find particular sections he is looking for. They are related to the text not by notation, but by their proximity to it. They are prominent because of their position, the space around them, and the size of type used. They reduce the information contained in sections of the text to a few words. Headings can be placed either in the text itself, or in the margins; occasionally a whole page may be devoted to a single heading, if it is sufficiently important.

There is considerable variety in the number of headings used in the texts under examination. Cambridge Consultants have none at all (see Fig.13). This means that the text appears as an undifferentiated sequence of frames. Although Lambton provides chapter headings, she uses very few in the text itself, and as some chapters are over twenty pages long, this makes scanning difficult (see Fig.14). Markle has chapter and section headings in the top margin, but few in the text itself (Fig.15).

Prosser (see Fig.16) makes a more extensive use of headings. The top margin of the left-hand page carries the title of the book; this is hardly something that needs to be repeated on every page. The top margin of the right-hand page carries the chapter heading. In the text itself, there are two sizes of heading; the more important headings are in large heavy type, and the lesser ones in lighter type. There are clear spaces around each heading. Italics are used for headings in
the body of the text, as in the examples given, e.g.

The episcopate.

Good uses the side margin to give information about sources and also to provide glosses on the text. There are also headings in the text itself. There are no recurrent chapter or section headings in the top margin. The glosses in the margin make use of different type faces to list book titles (see Fig. 17).

Horn makes an extensive use of headings (see Fig. 18). Each page, or information map, has a title, which goes at the top of the page. Each of the blocks of information on the page has a heading in the left-hand margin; these are often standardised and recur frequently e.g. Introduction, Example Block, Definition, Background. This is part of Horn's aim to have standardised formats for different types of information maps which the reader can recognise quickly and easily. Horn's marginal headings use the same type and form as the text itself. Chapter headings are another type of heading in the text. Both Markle's (see Fig. 19) and Richards' (see Fig. 20) are relatively small and are not easily found on a quick scanning of the text. If anything, Richards' are easier to find, since the space around them is the only space that occurs in an otherwise continuous text. Whitworth uses coloured headings for chapters, but the type is not markedly larger than that used in the rest of the book. Jolley gives the most space to headings; a whole page, which is always coloured green. These are always right-hand pages,
and are easy to find on a quick scanning of the text. An obvious attempt has been made to mark the main divisions in the text clearly.

2.5 Cross-References

Only two of the texts under consideration use cross-references: these are Richards and Horn. Richards provides very general references in the body of the text in the form 'see Chapter X'. These references may be too imprecise to be of much use. The point of cross-references is to allow the reader, while he is reading the text, to locate with accuracy information related to the section he is reading. This may be before or after the section in question.

Horn (see Fig. 7) gives examples of a text which uses cross-references. These are placed at the foot of the page, or information map, and simply state 'related pages', and give the page numbers. The examples he gives show three cross-references in each case. The way in which these references are related to the part of the text being read is not specified. It might be worth indicating the position of cross-references, either before or after the page in question, by using an arrow.

In Chapter Nine of this thesis, references to subsections of the Prosser text are given in the body of the main text, in the following form:

(3.1 Open and Closed-Circuit Television)
(3.2 Technical Problems)
(3.3 Teaching Problems)
A. 14-15 has latest E.F.T.

B. Diagram of project timeline:

C. 45 days from the start of the project.

Fig. I.3. Cambridge Consultants.
11. The qualifying 'ešafe follows the same rules as those given in Lesson II, paras. 6 and 7 for the 'possessive' ešafe if the word to which it is added ends in the 'silent' ُ, ُـ, ُـُ, ُـُ, or ُـُُ, e.g.

ketāba yā bożar, big books.
sandaliye nūt, the new chair.
baccayye kusek, the small child.
parye nūt, the new spade.

12. If more than one adjective qualifies a noun, the 'qualifying' ešafe is added to each adjective except the final one, e.g.

ketāba bożorge nūt, the big new book.

13. The noun and its attributes are regarded as a syntactical whole and, therefore, if the noun is indefinite, the Indefinite ُـُ is added to the final adjective only. Similarly if the noun is definite and the direct object of the verb, the ُـُ is added to the final adjective, e.g.

ketāba bożorgi, a big book.
katabe bożorge nūt, a big new book.
katabe bożorgra avard, he brought the big book.
katabe bożorge nūtra avard, he brought the big new book.

14. The comparative and superlative degrees are formed by the addition of ُـُ tar and ُـُ ُـُ tar respectively to the positive, e.g.

bożorg, big.
bożorgtar, bigger.
bożorgtarin, biggest.

Exceptions are:

xub, good.
behtar, better.
behtar, best.¹

¹ boh is also used to mean 'better' when it stands alone as the predicate of the verb 'to be'.

15. The comparative follows the noun it qualifies, the ešafe being added to the noun, e.g.

ketāba bożorgtar, the bigger book.
katabey bożorgtar, the bigger books.

16. The superlative precedes the noun it qualifies. It does not take the ešafe, e.g.

behtar ketāb, the best book.

17. Comparison is expressed by the word ُـُ ُـُ preceding the person or object used as a standard of comparison, e.g.

an parin az in dēxtar bożorgtar ast.
That boy is bigger than this girl.

man az soma zudatam adām, I came earlier than you.

Comparison can also be expressed by the word ُـُ ta preceding the person or object used as a standard of comparison. This form is used if the person or object used as a standard of comparison is governed by a preposition, e.g.

biflar ketāb be man dād ta be u, he gave more books to me than to him.

18. biflar and bish both mean 'more'. The former is used as a noun, adverb or adjective, e.g.

biflar be u dadid, You gave him more.
aorv biflar dust dafifand, They liked him better (more).
mardhav biflar budand ta ṭanah, There were more men than women.
would you call the verbal material in this frame a RU? (Is it a rule, principle, generalization, definition?)

Calculate the mean of the following IQ scores:

Whenever a question asks "would you," your answer is correct. However, we will have to
free, for purposes of communicating. Let's say that directions to the student, telling him
that to do, but NOT how to do it, is not what the authors meant by RU. The above
section, then, is not a RU.

Words beginning with the prefix in- meaning "into" DO NOT take the
negative prefix in-.
The negation of INCLUSIVE is INCLUSIVE.

There is a RU and there is an EG. What is strange about the relationship of that RU to that
EG? Does the RU prime the answer?_____.
Is the RU a prompt? (Does it help?)______.

The RU does not tell the student what to do; it tells him what not to do.
(To prime it, we would have to give the positive RU—tell the student to use un-.)
(If, at that point in the program, the student had learned only two negative prefixes, in- and un-. If he attends to the RU, he can't miss. The frame is from WORDS.)

Not given you in the article is another set of symbols. The RULEG authors talk about the
importance of including non-examples or noninstances of a concept when training in the
concept. (You want to be sure that the student knows when not to apply the rule or what
not a "mammoth" as well as how to apply the rule and what the correct name is for a
particular object.) These "negative instances" are called EG-bars and written EG. In this
situation, what would the RU above be?__________________

RU or RU-bar (not discussed in the article).

Fig. 15. Merkle. S.M.
Magnetic boards

These are made from thin sheets of iron, and metal backed materials can be made to adhere to the board by using small magnets. These are particularly useful when it is necessary to move parts of diagrams to different positions, as the materials can be moved easily along the board by moving the magnet without becoming detached. These are not an alternative to the flannel board but they have the obvious advantage of being used reasonably easily out of doors. But they are of course much more expensive than the flannel board and heavier to move around. If the magnetic board is painted black it can also be used as a blackboard for normal purposes.

Projectors

Here are a few of the most important types of projectors will be discussed.

1. The episcopé—this is sometimes called an opaque projector as it is used to project opaque objects and pictures such as photographs, illustrations, maps, charts and hand written material. It is a very simple piece of equipment in which the material is illuminated with reflected light and projected on to a wall or screen. A darkened room is generally necessary for the use of the episcopé, but it is very useful in that it can project any non-transparent image.

2. The epidoscopé—this is a combination of an episcopé and a diascopé. (The diascopé is another name for a magic lantern which can be used with prepared transparencies.) This piece of equipment can be used for either opaque material or transparencies. It is a more complicated machine than the episcopé but where it is necessary to show slides it has the advantage of combining both purposes.

3. The overhead projector—this machine projects an image from a slide or transparency back over the shoulder of the operator to a screen. This machine has many advantages: it is in the front of the class and hence the instructor-teacher can see the faces of all the students; the projected picture can be seen clearly in an undarkened room which helps note-taking and makes special conditions unnecessary; the teacher can draw on the screen which helps in explanation and makes the projection a more integrated part of the lesson or lecture.

4. The cineprojector—which is for motion picture projection. It is an expensive and complicated piece of equipment. The most usual size film for educational purposes is the 16 millimeter film. There are three main types of projectors: those for silent films only, which are cheaper but have obvious limitations; those for sound films which can be used also for silent films; and the multi-size which will project films of different widths.

Audio materials

This group includes the radio programme, the tape and the gramophone record.

1. Radio programmes should be integrated into class teaching. Special radio programmes can be used whilst the class is in progress and will provide the basis of the teaching content. However, there are many radio programmes which may not coincide with the timing of a class meeting but which can be brought to the notice of the class as supplementary teaching. Where actual classes are held with long intervals between meetings such radio programmes can help to provide continuity and provide an added stimulant to the student.

2. Tapes and Records have been proved especially useful in the teaching of languages but their use can be extended to other forms of teaching. Complete courses in any subject can be recorded on tape and be used to advantage in adult classes. Where there is a shortage of teachers, the use of tapes can help fill the teaching gap by providing material for use by a class leader who may, though familiar with the subject, hesitate to call himself a teacher. Also taped material can be used as supplementary to the main teaching especially where expert lectures or discussions have been precorded.

Audio-visual materials

Film strips with commentaries, sound films and television programmes are audio-visual materials which can get the nearest to face-to-face teaching. They can never, however, completely equal
Parliamentary Records

The following documents reveal actions taken at the Parliaments called by Edward I, and some of the reasons behind these actions.

PARLIAMENTARY SUBSIDY, 1283

The king to the mayor, sheriffs, and all the people of London, greeting. We are exceedingly grateful to you for having granted us a subsidy of one thirty of all your movable goods for our expedition in Wales,... on the condition that the magnates of the kingdom would grant the same amount. And we wish you to know that, at our request, the magnates have agreed to grant the subsidy. And since we greatly need the money for the sake of our expedition in Wales, we have assigned [three collectors] to assess the tax and collect it...

CONFIRMATION OF THE CHARTERS, 1297

Edward, by the grace of God king of England... to all who may see or hear these letters, greeting... Whereas some people of our kingdom fear that we will routinely expect to collect the aids and taxes which they have specially granted us for our wars and other needs,... we have granted for us and our heirs that we will not make these taxes permanent in the future. And we have also granted that... on no account will we collect such aids and taxes except by the common assent of the whole kingdom and for the common benefit of the whole kingdom... 

A PARLIAMENTARY BILL, 1301

Bill of the prelates and nobles delivered to the lord king on behalf of the whole community in the parliament of Lincoln in the year 1301.

If it pleases our lord king, the community is of the opinion that the charter of liberties and the charter of the forest shall be observed in all particulars from now on. [The king's response:] It expressly pleases the king.

And statutes that conflict with these charters shall be declared null and void. [The king's response:] It expressly pleases....

And the areas that have been surveyed according to the provisions of the charter shall be promptly disforested according to the boundaries determined by the surveyors. [The king's response:] It expressly pleases...
CHAPTER 2 WRITING INFORMATION MAP BOOKS

Introduction
To show how the rules and policies guide the writing of information maps and to give the reader some experience with actual learning materials, we describe in this chapter some major types of maps and illustrate them with sample pages. These are taken mainly from the book on sets and probability that we used in the research to be reported in later chapters.

Not all of the various types of information maps can be illustrated by this subject matter. For example, there would be no need in this material to use a process map, one that shows a structure changing over time.

Map Classification Chart
A full listing of the present classifications of map types and the kinds of information blocks that may appear on each is presented in the appendix. Because information mapping is a growing, changing system, we do not regard these lists as being fixed or complete. It is probable that deeper explorations into quite different subject-matter areas would reveal the need for other map types.

The Guidelines
This chapter describes the current state of the guidelines for writing some of the common types of information maps. Many of these are necessarily general in phrasing. And obviously, no matter how specific they might become, they cannot eliminate the need for competent writers. Many of the more important maps (such as reviews, previews, and summaries) require a certain degree of "artistry" in order to be properly effective.

The task of working up interesting examples and feedback questions is especially burdensome and demanding because information map books use so many of these. The skill with which this task is done makes all the difference between an amusing, challenging book and a dull, boring one.

This Chapter
In our descriptions on the following pages, we assume that decisions have already been made about the major curriculum issues: the scope of the project, the nature of the intended audience and specification of the desired learning outcomes. In this chapter we illustrate the nature of the writing task from that point on.

The chapter ends with an account of some of the content characteristics of a completed set of information maps.

continued on next page

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Fig. 18. Horn, R.
Chapter 2

The Basic Elements and Operations

INTRODUCTION

This book is called a grammar because it tries to do what a grammar of a language would do. It contains a classification scheme of the basic elements (or structures) and operations (or procedures) and a survey of the possible ways of combining these elements and operations into "good" forms. As with many grammars, you could also expect considerable practice aimed at eliminating from your repertoire certain inelegant or unpermitted ways of combining the elements and operations.

Programing is a rapidly changing technology. Classifying different frames as being this or that type could become an academic exercise if you were led to believe that all possibilities had been covered. So let me point out right now that new possibilities will be discovered—perhaps by you. Likewise, all rules are made to be broken, as the history of attempts to make rules about frames illustrates. So there will be more emphasis on what is "bad" design and why than on the way you "ought" to write frames. In the last analysis, only the students you are producing instruction for can tell you what is "good" design—by learning.

The concern of this chapter is with the operations of priming and prompting, with special emphasis on the latter because of its complexity. A third operation, testing, has already been considered in our discussion of terminal frames in Chapter One. The basic elements to which these operations are applied are the various types of behaviors to be learned. While some scholars feel the need for more than four categories (see Gagné, 1965, with eight), many programers use the four-way categorization: discriminations, generalizations, chains, and concepts.

The following unprogramed review is provided for the benefit of those whose laboratory psychology is rusty. Those who do not meet the prerequisite of familiarity with basic terminology and procedures in operant conditioning may wish to branch to a suitable text, such as Ferster and Perrott (1968), Mechner (1967), or Englemann (1969). Students who do not need to review these terms may skip ahead to page 58, Section A. Priming.

The smallest number of categories found workable is the operant conditioning model, which has the four: discriminations, generalizations, chains, and, for more recent work in verbal subject matters, concepts. With only four categories into which you can put all "mastery behavior," you should be able to deduce that these categories are quite broad! The broader a category (or concept) is the more difficult it is to master because one example may appear to be so completely different from another.

Here are the four categories, with examples.

**Discrimination:** In the presence of an appropriate stimulus, a learner makes an appropriate response, a response he does not make to other stimuli. In other words, he can tell two or more stimuli apart.

---

Fig.I9. Markle, S.M.
CHAPTER XVI

THE ANALYSIS OF A POEM

Toutes choses sont dites déjà, mais comme personne n'écoute
il faut toujours recommencer.—André Gide.

The qualifications of a good critic are three. He must be an adept at experiencing, without eccentricities, the state of mind relevant to the work of art he is judging. Secondly, he must be able to distinguish experiences from one another as regards their less superficial features. Thirdly, he must be a sound judge of values.

Upon all these matters psychology, even in its present conjectural state, has a direct bearing. The critic is, throughout, judging of experiences, of states of mind; but too often he is needlessly ignorant of the general psychological form of the experiences with which he is concerned. He has no clear ideas as to the elements present or as to their relative importance. Thus, an outline or schema of the mental events which make up the experience of 'looking at' a picture or 'reading' a poem, can be of great assistance. At the very least an understanding of the probable structures of these experiences can remove certain misconceptions which tend to make the opinions of individuals of less service to other individuals than need be.

Two instances will show this. There are certain broad features in which all agree a poem of Swinburne is unlike a poem of Hardy. The use of words by the two poets is different. Their methods are dissimilar, and the proper approach for a reader differs correspondingly. An attempt to read them in the same way is unfair to one of the poets, or to both, and leads inevitably to defects in criticism which a little reflection would remove. It is absurd to read Pope as though he were Shelley, but the essential differences cannot be clearly marked out unless such an outline of the general form of a poetic experience, as is here attempted, has been provided. The psychological means employed by these poets are demonstrably different. Whether the effects are also dissimilar is a further question for which the same kind of analysis is equally required.

This separation inside the poetic experience of certain parts which are means from certain other parts which are the ends upon which the poetic value of the experience depends, leads up to our other instance. It is unquestionable that the actual experiences, which even good critics undergo when reading, as we say, the same poem, differ very widely. In spite of certain conventions, which endeavour to conceal these inevitable discrepancies for social purposes, there can be no doubt that the experiences of readers in connection with particular poems are rarely similar. This is unavoidable. Some differences are, however, much more important than others. Provided the ends, in which the value of the poem lies, are attained, differences in the means need not prevent critics from agreement or from mutual service. Those discrepancies alone are fatal which affect the fundamental features of experiences, the features upon which their value depends. But enough is now known of the ways in which minds work for superficial and fundamental parts of experiences to be distinguished. One of the greatest living critics praises the line:

The fringed curtain of thine eyes advance,

for the 'ravishing beauty' of the visual images excited. This common mistake of exaggerating personal
This allows the reader either to continue reading the main body of the text or to refer to a more detailed subsection, which is placed in the second 'layer' of the text, after the main body. This is part of a more general scheme which divides the text into layers which can be read serially, or else vertically, by moving from one layer to another. It would also be possible to have cross-references within each layer. However, in the texts being examined here, very little use is made of cross-references in comparison to other devices.

2.6 Format

The layout of the text on the page affects scanning of the total text. Variations in type sizes and style; the use of spaces to emphasise the unity of sections or paragraphs; the use of coloured print; variations in the length of line; all these may influence the ability of the reader to pick out items in the text, or generally to orientate himself.

Relatively undifferentiated layouts can be seen in Lambton (figure 14) and Markle (Fig.15). In Lambton, it is difficult to distinguish explanation from example, and the new sections (denoted by numerals) are given no special positioning. There is no differentiation of type size. A line, broken where there is continuous English text, down the centre of the page, dividing the Persian from the English translation, might have made the examples clearer.

The Markle text is programmed, with the frames varying considerably in size, but averaging about three to a page.
The frames are numbered (e.g. 41, 42, ...) and divided from each other by horizontal lines. Rectangles within some frames enclose examples of frames in other programmes. Broken lines provide a place for writing in answers to frame questions. A covering shield is supplied with the book, so that by moving it gradually down the page, the reader can uncover, first the question, next the answer space, and then the correct answer. There is no differentiation of type or margin in this text. Spacing is not used for emphasis; the overall effect is relatively uniform, and unless the reader actually starts work on a frame, scanning is difficult.

A conventional but clear use of spacing and type sizes is found in Prosser (see Fig.21). Space is left between the main sections, and the listed items are indented. This kind of format might well catch the eye quickly with a familiar or interesting heading. Although there is nothing unusual about the layout of the text, it is nevertheless clear and ordered, and some care has been taken with it.

A less usual feature of Whitworth (see Fig.22) is the greater use of space altogether. Single sentences are allowed to stand on their own, presumably because this isolation will earn them greater attention than if they were embedded in a paragraph. Coloured lettering (blue) has been used for the heading, and heavy type to emphasise the two key words, analogue and digital. There is no differentiation of type size in the text in this particular example, and in general little in the book. This particular format is near
to being a programmed one (the text is described as a programme) despite the absence of frame lines or numbers. Questions are posed at intervals, not for each frame. Despite the greater spaciousness of the layout, the total impression is of an undifferentiated text with few headings. Spacing is so common that it no longer indicates a particular break in the order.

McLuhan (see Fig. 23) is an example of format which uses type, pictorial or diagrammatic elements and space in a manner common in advertising, but uncommon in educational books. The whole of the book, The Medium is the Massage, is an adventure in format and presentation. Image and word are blended to produce a joint effect. Although illustrations are commonly used in textbooks, this kind of amalgam is rare. Some of the print in McLuhan's book is large enough to be read even when flicking the pages over quickly, and the images can make an immediate impact. Whether such techniques are acceptable in textbooks is debatable, but at least the possibilities of this kind of presentation can be considered. The role of visual images in scanning for retrieval could be investigated by having similar texts, one of which contained a small number of representative graphics, either diagrams or photographs, at strategic points. It might be found that these affected which parts of the text were studied and in what order, and the semantic effect of the visuals on the interpretation of the text could perhaps be assessed. Readers might look at the photographs first, and then tackle the text itself, using the photographs as organisers. It might also be useful to give
way of life by the community as a whole. Most field officers are concerned with the introduction of new ideas. As a rule, such officers and their assistants are highly qualified in their chosen professions whether agriculture, administration, health, community development, labour relations or co-operative organization. Rarely, however, are they trained to communicate their special knowledge in the most effective and speediest manner, or to make an objective study of the learning processes of those who they have to teach. Trained professional adult educators should be available to teach this subject whilst such specialist personnel are acquiring their initial vocational training. These teachers of adult education should be attached to all institutions where training of all cadres of agriculturists, health workers and the many other grades of field workers is carried out. Adult education can profitably be introduced as a compulsory subject alongside the main academic subjects of the curriculum. Only in this way can there be any assurance that the specialized knowledge which they acquire can be effectively introduced and systematically taught to those for whom it is intended.

Training of field workers and instructors

From the village to the district level, all personnel working with the people will find themselves involved in teaching. True specialists are few and far between and all staff to some extent will find themselves multi-purpose teachers and instructors.

The primary cadre of field worker: agricultural assistant, health worker, community development assistant, administrative assistant, and the many others, must have some training in methods of communication as well as their specialism.

All primary training courses whether for multi-purpose workers or specialists should as a minimum include all of the following five elements to allow these personnel to make full use of their knowledge and skills:

1. Adult approach

Methods of gaining the confidence of adults—simple adult psychology—how adults learn.

2. Adult teaching methods and aids

How to teach adults—techniques of instruction (outdoor and indoor)—simple use of teaching aids.

3. Community development techniques

The organization and skills of “self-help”—project work—development of new “need” patterns.

4. Organizational and leadership training

Practice in organization—simple theory of organization and chain of responsibility—the qualities of leadership.

5. General background

Simple understanding of the basic economic, social and political structure of the local and national situation.

Proper training of all personnel workers in adult education is an essential that cannot be avoided. It must form the basis of any sustained effort to develop adult education to be accepted as part of the normal natural processes of life. Where rapid national development is required, adult education holds the key to its success. Only careful and thorough training of those responsible for carrying out these programmes will ensure the achievement of this objective.
section 1
computers in business

There are two quite distinct families of computers, analogue computers and digital computers.

Analogue computers are very different from digital computers.

Digital work is ordinary alphabetical and number work with the usual arithmetic processes.

You create an analogue situation by giving values some actual, as opposed to numerical, form. When asked how long was the one that got away, the fisherman may reply digitally, 'Eighteen inches', or he may give an analogue answer with his hands. A motor-car's milometer is digital but the speedometer is analogue. Despite the numbers on the dial and our translation into numerical terms, speeds are represented by the position of a pointer and not by numerical digits.

When you use a slide-rule, you manipulate actual lengths of wood (or whatever). Thus, a slide-rule is a sort of analogue computer.

Real analogue computers usually represent values by electrical potentials. They are used to simulate complicated industrial processes.

This course is about digital computers. Analogue computers belong to a different field.

Fig.22. Whitworth, D.
page references to relevant parts of the text under each visual; in this way, the reader could move directly from the visual to whatever part of the text interested him first. The role of visual illustrations in textbooks is a large subject, which has been investigated by Smith and Smith, but must be left here, as it is a whole area of enquiry in itself.

Horn also experiments with format (see Figs. 24, 25). He divides each page into 'blocks' of information which are separated by lines. These boxes are subdivided further to show procedures, give examples, and show contrasting information. These 'blocks' of information can be displayed on computer terminals as well as being used in text presentation. It is possible that for someone accustomed to reading uninterrupted prose, such a format is less clear and manageable, at least at the beginning. However, Horn's work suggests that it may be useful to investigate new formats which, unlike consecutive prose, attempt to mirror the organisation of the content with the organisation on the page.

2.7 Notation

The notation in texts gives the addresses of items of information referred to by descriptors. It either relates descriptors outside the text to items in the text, or descriptors in the text to items in the text. Indexes and tables of contents are examples of the first; cross-references are the only example of the second.
Notation in textbooks is a relatively straightforward matter. The notation can be in numerals or letters, or a combination. All the texts reviewed here use numbers except Ranganathan (see Fig. 26) and Garland, who use letters. These numbers or letters can be used to indicate a series, or a hierarchy. Page numbering is a simple series, as in frame numbering in programmed texts. Both Lampton and Ranganathan indicate hierarchical relationships in their notation. The main sections are notated A or 1 and subsections are AA, AB, AC, etc., or 1.1, 1.2, 1.3 etc. These notations merely indicate general hierarchical relationships; it cannot be assumed, for example, that the relationship between section 2 and subsection 2.1 is exactly the same as that between sections 2 and subsection 2.3.

Notation can be either to pages or sections. Ranganathan uses sections, while all the others use pages. The advantage of using section notation is that the reference has a precise beginning and a precise ending. The disadvantage is that references may run across section boundaries, including several parts of different sections. In the latter case, pages provide a more accessible unit, although there is always the difficulty that the reader is not sure where in the page the reference starts and ends.

Page numbers in the texts are placed at the top or bottom outside corner of the page. Numbering for sections and frames can be given either in the margin, or in the frame itself. Numbers placed on the outside of the page are easier
CHAPTER LE

CANONS FOR HOSPITALITY IN CHAIN

1 Regions for Accommodation
A chain of numbers (See Sec CF1) contains a succession of subordinate numbers beginning with the number representing the whole universe of entities. It will have to show its hospitality to a new-comer by accommodating it only either at the end or between any two consecutive succession of subordinate numbers; for a subordinate number cannot obviously be accommodated above the number at the top which is the largest in the chain.

2 Extrapolation
To accommodate a new number at the end of a chain—that is, to accommodate numbers of higher order than the number at the end—it should be possible to extrapolate any number of a new succession of subordinate numbers to the chain. The canon governing this and the notational devices by which it can be achieved are examined in Chap LF.

3 Interpolation
To accommodate a new number between any two already existing consecutive numbers in the chain, it should be possible to interpolate any number of a new succession of subordinate numbers between any two already existing consecutive numbers in a chain. This problem is examined in Chap LG.
CHAPTER 10

File maintenance

10.1 INTRODUCTION

Almost all files are dynamic structures of information, changing often in content, and occasionally in structure, sequence, or storage medium. In many, and possibly the majority of retrieval systems, more time and money are expended on maintaining files than on searching them. Indexing of new accessions, and the posting of new index records to index files and of new documents to document files are examples of file maintenance transactions. The speed and efficiency with which these operations are carried out often determines the cost or feasibility of the entire system. We are often constrained to organize file sets for optimum maintenance efficiency rather than for optimum search efficiency or speed. A system designer should never lose sight of the fact that well-maintained files are as much a user requirement as the ability to do high-speed searching, although he will rarely hear a user say so.

10.2 FILE MAINTENANCE PRINCIPLES

The function of file maintenance consists of, not just one, but a collection of file processes whose results are the incorporation of new records into a file, deletion of obsolete records, and modification of others, or a change in record positioning. Most sorting and merging operations in retrieval systems are performed as part of file maintenance, as are many matching operations. It has been estimated that sorting alone can use as much as 20 to 30 per cent of total machine time in general business applications.

We shall review the foundations upon which maintenance functions are based, and, in the next section, present a few examples to show how maintenance requirements can come to dominate the entire approach to file organization and processing.

10.2.1 Types of Maintenance Transactions

Maintenance transactions can change the membership of a file, the values stored in records of a file, or the structure of a file. Specifically we can perform the following:

1. Add a record to a file
2. Delete a record from a file
3. Change the value of a field in a record
4. Change the structure of a record
5. Change the sequence of records in a file
6. Change the medium on which the file is stored

Adding a record is identical to merging new records with existing records to produce a new file.

Deleting requires a search to find the unwanted records, followed by what amounts to a negative merge, creating a new file without the matched records. In add and delete operations the domain is less than the full file.

Changing the value of a field (such as correcting a spelling error or changing the address of the next record in a chained file) or the structure of a record (by adding or deleting a field in a repeating set, changing the number of digits allocated to a given field, or changing the sequence of fields within a record) can be performed in individual specified records, or these operations can have an entire file as a domain. The latter would be the case if, say, a new coding scheme were initiated for part numbers, requiring more digits than had previously been in use. Then each part number field would be changed in value and in size. Although this type of change does not occur often in any system, it happens occasionally in every system, and ability to handle the requirement of making these changes without completely redesigning or rebuilding the system is a measure of the quality of its design.

Changing record position, or sorting, is an operation performed on an entire file, although individual records can be moved, in effect, by combinations of adding and deleting operations. Sorting of input data, before posting it to a file, is an almost universal system requirement. Resequencing of a file that has already been in operation is rare, but, just like restructuring records, it can be necessary on occasion. Sorting a chained file periodically, to speed searching, is an example.

When we change the medium on which a file is stored, we have changed the file organization and probably the access coefficient of the file. This, in turn, may lead to the adoption of new searching plans.
to scan than numbers placed nearer the spine.

The notation is not always used to link descriptors and text. Markle uses frame numbers in the text, but does not give them in the table of contents. Lambton uses both page and section numbering in the text, but gives only page numbers in the table of contents (see Fig.3).

The most detailed notation is used by Meadow (see Fig.27) who indicates four levels of organisation, both in the table of contents and in the text, as in the following example:

Part II THE ORGANIZATION OF INFORMATION

5 The Organization of Records

5.1 Introduction
5.2 Principles of Record Organization

5.2.1 Record Structure
5.2.2 Expressiveness

16

In the text, the headings appear with different type sizes and surrounding spaces (see Fig.27).

Very little notation occurs in Cambridge Consultants, where the frame numbers are given in a simple progression. These numbers are not linked to any descriptors within or outside the next.

5. General Comments

The aim of collecting these examples has been to suggest the range of possibilities within each retrieval device, and to a lesser extent, to comment on the organisation of devices as a system. These final comments will deal with two aspects:
the numbers of devices found in each text, and the design of individual devices.

Cambridge Consultants and McLuhan have only one device; page numbers. McLuhan provides a list of sources of photographs at the end, but this is for the purpose of acknowledgement. The pre-programme quiz in Cambridge Consultants may serve to orientate the reader, but its main purpose seems to be to ensure that readers who already know what the programme is about, do not work through it unnecessarily. While there are features in McLuhan which suggest that the layout of the book is conscious and deliberate, there is nothing in the Cambridge Consultant's text which suggests this. Part of the argument McLuhan is advancing in the book is that Western society is moving away from a print-based, linear culture to a culture more aware of aural and visual stimuli. The organisation of the book to make the maximum visual impact, and the placing of the printed text in the framework of powerful visual images, suggests that McLuhan is trying to practice what he is preaching. It is possible that for this reason he has not provided 'print' devices such as a table of content, or an introduction. McLuhan is best viewed as a case where retrieval devices do not fit in with the overall design of the book; this underlines the point that the design of the text must be related to the objectives of the text. McLuhan is not attempting to write a textbook in the conventional sense, although his intention is clearly didactic.
There is no sense, in the Cambridge Consultants book, of the design of the book being related to some overall objective. As a programmed text, the authors' main concern is with the writing and sequencing of frames, but a comparison with Markle's programmed text, where care has been taken to orientate the reader with an introduction, table of contents, an index and some headings suggest that the absence of these features in the other programmes is due to lack of thought rather than conscious planning.

A number of texts - Good, Jolley, Meadow and Ranganathan - have a large number of devices. Of these, Meadow is an example of a book in which the provision of devices has almost been overdone; his table of contents is extremely detailed, and headings proliferate. The detail of these devices is not matched by an adventurous use of format to show the divisions in the text, but the total impression is nevertheless of a well-planned book. Jolley provides a very detailed index, a long introduction, clear headings but a cryptic table of contents; in the introduction, Jolley may have given too much information for the reader to cope with.

The rest of the texts fall in between these extremes of scant and generous provision, with some devices but not others.

The most unusual use of devices occurs in Horn and Ranganathan. Horn makes extensive use of headings, and to judge from the examples of other texts he gives, cross-referencing, maps and diagrams. He uses the format of information blocks to delineate the semantic structure of the information being presented. It has been argued, in Chapter Four, that the
rationale behind Horn's work is somewhat confused; this does not invalidate some of the features of his texts. However, in order to be tested properly, they must be isolated one by one, and their individual effectiveness assessed.

Ranganathan's text is interesting as regards notation and indexing. The notation makes use of numbers and letters, and the text is organised in small sections which are indexed. The index also indicates relationships between entries.

Apart from these two writers, the texts did not contain much that was unusual, despite efforts to select texts which had uncommon devices. The impression is of varying degrees of competency in the design of various devices, but of little evidence that the problems of retrieval have been foreseen. Apart from a few remarks by Richards, Markle, and Jolley, none of the texts (with the exception of Horn, who is investigating these problems) gives evidence in its introduction of wanting to help the reader to manipulate the material. This can either be because the authors do not want the reader to do so, which may be possible in the case of McLuhan, and programmed texts, or because they have not seen the problem. It may be that, as distinct from general competence in the design of individual devices, a conscious design of the whole text for retrieval can only come from a general analysis of the problem, with a complete theoretical framework. Otherwise the development of new devices such as structural tables and co-ordinate indexes, or the extension of older ones like cross-references can only occur by chance.
The examples in this chapter may not be representative of adult textbooks as a whole. It is felt that effort is better put into the design and testing of new books and devices, than into collecting detailed information about the present situation, where intuitive judgment seems in any case a competent guide. These examples have given some indication of the state of the art; in the next two chapters two new possibilities will be examined: structural tables and re-ordered texts.
REFERENCES TO CHAPTER SEVEN

Since there are frequent references to a limited number of books in this chapter, which are often referring to the design and format of the books rather than specific pages, the references listed here have been confined to references to passages quoted from the books, and references to books others than the ones being analysed. In the cases of the fourteen texts under analysis, only the name of the author(s) has been given. A complete list of titles can be found in section 1.5.

1. CAMBRIDGE CONSULTANTS, LTD.
2. WHITWORTH, W.
3. JOLLEY, J.L., p.10.
4. PROSSER, R.C.
6. MARKLE, S.M., p.xii.
7. JOLLEY, J.L., p.119.
8. RICHARDS, I.A., p.296.
10. ibid.

12. JOLLEY, J.L., p.244.


CHAPTER EIGHT

STRUCTURAL TABLES

1.1 Introduction
1.2 Examples of Structural Tables
1.3 Construction of Structural Tables
1.4 Conventions of Structural Tables

2 Examples of Structural Tables
Figures 1 - 14
CHAPTER EIGHT

STRUCTURAL TABLES

It was suggested in the sixth chapter that a diagrammatic representation of the semantic relationships in a unit of text material would be a useful addition to the retrieval devices normally found. This chapter explores this idea further, and presents some examples of what is envisaged.

In the analysis of retrieval devices in Chapter Six, it was argued that tables of content were better known as sequence tables, in that they sometimes give only a scanty account of the total content of the text, but always give some indication of the sequence of content. The rationale behind this sequence is either a semantic or a psychological one of the kinds described by Mage. It was further suggested that the sequence table might usefully give additional information about possible branching from the sequence, pointing out different paths which the learner might follow. These paths would be seen as variations from a sequential norm; hence the use of the term 'branch', implying a variation rather than an alternative main path.

It was then pointed out that other semantic relationships in the text are perceivable. These can be displayed in a limited way in the index, where the intersection of a term (the entry) and other terms are shown, as in the following example:
Curriculum, 35; projects in mathematics, 54; building procedures, 70-72; project in social studies, 73-101; aims of social studies course, 101; needs, 159, 162-63. See also Evaluation.

Here the relationships are partly of the hierarchical type; the genus (curriculum) is subdivided into various species (mathematics, social studies), and various aspects, like building procedures and needs. Both mathematics and social studies have their own entries in the index. Evaluation has its own entry also:

Evaluation, 30; guidelines, 163-167; during curriculum-building, 54-55, 163-65; as instruction, 165; procedures used, 167-171.

In this case, there is a link back with curriculum ('during curriculum building'). Of the terms intersecting with curriculum, instruction has its own entry:

Instruction: nature of, 39; teachers' aids to, 98-101, 124; in language, 109-112; in hunting-gathering groups, 150-151.

If these three entries, curriculum, evaluation and instruction are represented diagrammatically (see Fig.1) the result is three clusters which are related in at least one way to one other.

It will be clear both from the entries and the diagrammatic representation of them, that the indexer is not simply entering terms in isolation; he is giving information about relationships between terms. These relationships are not specified exactly; it is indicated simply that two terms intersect, and it is left to the reader to judge from other entries which of
Curriculum
- projects in mathematics
  - project in social studies
- needs
  - building procedures

Evaluation
- procedures
  - during curriculum building
  - guidelines
    - as instruction
      - nature of teachers' aids to instruction
        - in language
          - in hunting gathering groups
the two is more important in that index. Since neither
'needs' nor 'procedures' has its own entry, it can be
assumed that they are dependent on the main terms 'curri-
culum' and 'evaluation' in this context.

The question then arises: what criteria is the indexer
using for his entries, and in particular for the relation-
iships he shows? Langridge raises this point in an article
on indexing:

A 'see also' reference does something beyond locating
specific items in the text — it shows a relationship
between two or more terms in the index. If 'see also'
references occur occasionally in indexes we are justified
in asking on what principle they are chosen, because if
we do not know, then they may be unnecessary or they
may be inadequate.

Langridge goes on to say that the indexer must to some extent
engage in an analysis of the subject, and produce a classific-
ation scheme to guide his choice. He compares this situation
with the situation in a library where both a classification
scheme, showing content relationships, and an alphabetical
index are available.

The most satisfactory method yet devised.....is the
arranging of books in a closely classified order
with an alphabetical index to locate specific subjects
and to show other groupings than those achieved by the
classified sequence. The individual book also has its
alphabetical index, but its text, corresponding to the
collection of books in a library, will at least be in
a very roughly classified order and we may expect
plenty of scatter of identical and related subjects.
The conclusion to be drawn from this comparison is
that, if the book index is to provide as effective a
key to its contents as the combined classification and
index do to a library's, it must take some of the
burden of a classification scheme.
Langridge is pointing to the need, in single books, for something corresponding to the classification scheme used for collections of books. At this point, the comparison between the single book and the collection of books in a library should be clarified. If the three retrieval devices of index, classification scheme and sequence table are listed, it will be seen that neither the single book nor the library has all three:

<table>
<thead>
<tr>
<th>Textbook</th>
<th>Library</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alphabetical Index</td>
<td>X</td>
</tr>
<tr>
<td>Classification Scheme</td>
<td>-</td>
</tr>
<tr>
<td>Sequence Table</td>
<td>X</td>
</tr>
</tbody>
</table>

Both stores of information have alphabetical indexes. However, books do not have a classification scheme, based on subject analysis, and libraries are not arranged in sequence according to psychological principles. If it is accepted that the rationale for sequencing a textbook is to be found in learning principles, and that this sequence is displayed in the sequence table, it follows that the job of subject analysis, or classification, must fall to another device. Langridge suggests that the index should take over this function, at least in part. It is equally arguable that a new device, the structural table, should be entirely concerned with subject analysis. There would thus be a clearer division of labour; the sequence table would deal
with sequencing derived from learning principles; the index would provide access through an alphabetical list of terms; and the structural table would show relationships in the material that appear from subject analysis.

A description of one technique of subject analysis has been given by Thomas and Augstein:

The technique for content analysis of each summary was based on Bloom's Taxonomy" (Bloom, 1956). Each chapter was analysed in terms of its 'knowledge' content. Items of knowledge were graded and classified in hierarchical order from "knowledge of specifics" to "knowledge of generalisations and theories". This meaning structure was then represented in a detailed flow diagram. Five, independent, informed judges were asked to analyse each chapter and their flow diagrams and lists of specifics were compared. (The differences were never very serious but were discussed among all the judges and an agreed hierarchical meaning structure was produced). Each summary was then analysed and mapped into this agreed meaning structure to produce a measure of nature and amount of omissions and lack of organisation.

There are several differences between this procedure and what would be needed in subject analysis of the type mentioned above. In the first place, the analysis of the material according to the level of generality or specificity does not take into account the aims and objectives of the text. If the text has as one of its aims the teaching of certain specifics, then it is arguable that these should be included in the meaning structure. Subject analysis, in an educational context must take some account of the aims of the content and the uses to which it will be put. A purely semantic basis for analysis is not enough. Secondly, there seems no reason why the meaning structure need necessarily be a hierarchical or subsuming one.
If the subject analysis shows a number of related terms of more or less equal importance, it would be misleading to try and force these into a hierarchical relationship. The examples given below contain hierarchies, but by no means all the relationships shown follow this pattern.

Finally, the above analysis was used to produce flow diagrams. The idea of 'flow' derives from the notion of sequence, and it has been argued that this belongs more properly to the sequence table. Classification schemes show relationships, but not direction; there is no suggestion in the Universal Decimal Classification that the reader should start at the beginning with .01 and work through to the .9 classes. There seems to be a confusion here between path analysis and subject analysis; subject analysis provides the information for the reader who wants to work out his own path; it does not itself specify paths.

1.2 Examples of Structural Tables

Since no examples of structural tables could be found in existing texts, it was decided to construct some, based on the chapters of this thesis. The advantage of using this thesis rather than another book or books is that the content of the thesis will be familiar to the reader, who can thus judge the usefulness of the tables more easily than if they referred to another text. The construction of these tables is described in the next section.
Two examples of diagrams which have some features in common with structural tables are given first. The first of these (see Fig. 2) comes from a thesaurus on Euratom, and is quoted by Vickery. This is a freely-built-up map showing relationships between various elements in the field of nuclear energy. The map provides a guide to a collection of documents, not a single document, and is thus on a much larger scale than any of the examples constructed for this thesis. Single-headed arrows point from a descriptor to a more specific descriptor; thus, from Control Systems to Startup. Double-headed arrows specify any other relationships. The map has a centre (reactor core) which is related to seven other elements; no other element is related to more than four others. Some of the descriptors are technical, and will make sense only to readers who know the field. The descriptors have no addresses, so the reader cannot refer directly to any part of the information store; presumably, he must first consult the subject index.

The second example is taken from an article by Jahoda and Thomas (see Fig. 3). This a much smaller-scale map showing content relationships within the article, divided into paragraphs. In contrast to the first example, this one has much fuller descriptors — sentences rather than words — and there is an overall direction of flow, from top to bottom. This suggests that this is a path, rather than a content analysis, showing relationships in the material not apparent from the serial order. There is a definite beginning and end, whereas
Fig. 2. Structural Table: Buratom.
P(1). The purpose of University education is to use all available techniques to encourage learning. Teaching is a means not an end.

P(2). Existing psychological theories of learning developed in the laboratory are not adequate for explaining undergraduate learning behaviour.

P(3). Attempts to explain learning may be made in terms of the teaching situation or in terms of characteristics of the student.

P(4). Learning is an inference from behaviour. Inferences from the teacher's point of view are called Type A and from the student's point of view are called Type B.

P(5). Emphasis on process rather than outcome.

P(6). The locus of control of the process of learning shifts backwards and forwards between the material and the learner. Control derives from feedback activity. This may be structured by the material or by the way the student defines his learning task.

P(7). One experiment studies students learning from three different sets of material.

P(8). The experimental method.

P(9). Results of the experiment—different strategies of learning.

P(10). The structure of material in the form of flow diagrams. Inferring the receiving state of the student from a comparison between the record of learning behaviour and the flow diagram.

P(11). A device for the detailed recording of learning activity.

P(12). The project as action research. Research influences staff. Staff experience used to formulate research questions.

P(13). Other parts of the project.

P(14). Action research aims to increase staff flexibility in use of a wider variety of skills, e.g. work on learning strategies might help staff to improve their tutoring, thus encouraging students to learn to be more able to learn by themselves, giving overall economies.
in the first map, there is a centre and a periphery. The difference between sequence tables and structural tables is shown by these two examples; the second example, although it may superficially appear to show structure, has been constructed as a sequence table with local variations, or branches.

1.3 Construction of Structural Tables

The structural tables which were constructed for this thesis follow the pattern of the first of the above two examples in that there is no overall direction of flow in them, and they tend to have central descriptors, or clusters of descriptors, rather than a beginning, a middle and an end.

Since no guidance, in the form of previous work, could be found for the construction of these tables, various strategies were tried. The first was to read through the chapter, noting down a descriptor for each paragraph as it was read. The long list of descriptors produced by this was then manipulated in diagrammatic form to display the 'structure' of the chapter. This consisted mainly of isolating hierarchies within the structure, and then relating these to each other. The result was a modified sequential table (see Fig.5) similar to the Jahoda and Thomas diagram. This was unsatisfactory because the sequence of the chapter was still apparent from the strong central line down the middle of the table (see Fig.6).
The branches from this are branches from a norm; the overall shape is recognisably tree-like. Examples of these first attempts to construct a structural table for the Second and Third Chapters are given (see Figs. 4, 5).

It was felt that the only way to construct a table which would be neutral from the point of view of sequence, and would indicate relationships in the way that a classification scheme does, was to forget as far as possible the sequence of the chapter. This meant putting the chapter aside, and constructing the table out of one's head, by asking questions like: 'What is the main point in the chapter?' 'Where is the core of the chapter?' 'How is the core related to other parts?' The tables that follow here show that in some cases there was no simple core of a single descriptor, but that there are recognisable clusters of descriptors, which relate to each other. When the main shape of the table had been drafted without reference to the text, the list of headings was again consulted, and omissions in the draft worked into the table. A comparison between the two types of table for the second and third chapters (see Figs. 4, 5) shows the different basic shape of the two types of diagram. The construction of the diagrams was an intuitive process, and it is difficult to describe in any detail. Certain comments can be made. The task of constructing them helped to clarify the author's mind about the organisation of the chapters concerned, and once they had been worked out in some
new media (devices)
educational terms: description and connotation
the concept of media
  print and electronic
  the media-based approach
the concept of systems
the concept of aids
  audiovisual aids
  the role of the teacher
the systems approach
  definition
  origins
  applied to instruction
  specifying objectives
  evaluation
design of instruction
locus of control in systems
  centralised control
  local control
  instructional systems and adult education

Fig. 4. Structural Table: Chapter Two (first version).
The dual function of the textbook

Textbooks as sequences of instruction

Textbooks as stores of information

Information retrieval systems

Definition of information

Information as an entity

Information as a process

Information retrieval as a communication mode

Presentation mode

Interactive mode

Search mode

Retrieval systems and instructional systems

Retrieval systems and the learner

Fig. 5. Structural Table: Chapter Three (first version).
detail, they were used as a reference point for further work on the chapter. Slight differences in the information displayed in the earlier and later versions of the tables for chapters two and three can be attributed to changes in the actual content; and these were partly due to the exercise of making the structural tables. This author feels that the exercise of making such tables can be an illuminating one for the writer himself; but it cannot be assumed that this would be so for all writers. Secondly, it is not suggested that these tables are the only possible ones for each chapter; the fact that two different tables have been produced for the second and third chapters, shows that these tables are to some extent subjective and variable. If such tables were being constructed for a textbook, it is envisaged that the final table would be the result of a consensus; a number of people, both 'experts' and 'novices' could read the text, and produce individual tables; these could be collated, or if consensus proved impossible, more than one table could be printed. This would point to structural ambiguities in the text, and might lead to a re-writing of parts of it. There are various ways in which the tables could be constructed; either on the basis of a reading of the text, as here, or providing people with a list of the main descriptors, and asking them to arrange them structurally; or presenting people with completed tables, and asking them to infer from these the content of the text in the form of a long summary. It might also be possible to
ask people to generate sequences from structural tables i.e. to guess what the most 'logical' sequence of content would be of a number of descriptors shown in structural relation. It must be emphasised finally that this area needs to be explored in much more detail than is possible here; these tables and the comments on their construction are only meant to suggest possibilities.

1.4 Conventions of Structural Tables

The diagrammatic conventions of the structural tables here have been chosen arbitrarily, and others are possible. The following conventions have been adopted:

a) Each table represents one chapter with the exception of the first which represents the whole thesis. No table has been constructed for Chapter Nine, since there is a table accompanying the re-ordered text in it.

b) The positioning of items on the page is not significant, although descriptors which are at the centre of clusters (i.e. related to a number of others) tend to be nearer the centre than the periphery.

c) The length of line between descriptors is not significant.

d) Lines join complete descriptors and not the words they happen to touch.
e) Relationships between descriptors are indicated by the language used; where there is any ambiguity, an arrow points from the descriptor or descriptors to which the descriptors in question is most closely related.

f) The number or numbers beside each descriptor is the section number in the text. The reader can thus refer from the table to the relevant section. The more accurate page notation has not been used because pagination of the thesis had to be left to the very end.
new media in adult education

mass communication and mass media

receiver-controlled communication

the process of information retrieval

design of textbooks for retrieval

information

instructional systems

locally-controlled subsystems

information as an entity

existing retrieval devices

new devices
definition of the textbook 2.3

the role of the textbook 2.2

textbooks 1

research on textbooks (general) 3.1

organisers and descriptors 3.3

research on retrieval from textbooks 3.2

Robinson and Hall 3.4

comments on textbooks as information stores 4

Christensen and Stordahl 3.4

Horn 3.4
definition of learner-control 1.2

objects of learner-control 1.3

learner-control of sequencing 1.4

research on logical sequencing 2.1

research on learner-control of sequencing

Hager 2.2

Silberman 2.2

Campbell 2.2

Jahoda and Thomas 2.2

Horn 2.2

2.2 3
1.1 Examples of structural tables

1.2 Author's examples

1.3 Construction of structural tables

1.4 Conventions of structural tables

- Euratom
- Jahoda and Thomas

First version
Second version
Suggestions for experimental research 1.2

Suggestions for design and development 1.2

Textbooks as Information Stores 1.1

The role of information subsystems 2.1

Analogies from information systems outside education 2.1

The uses of analogies in educational thinking 2.2

Information subsystems and instructional systems 2.1
REFERENCES TO CHAPTER EIGHT


3. Ibid., p. 174.

4. Ibid.


6. Ibid.

7. THOMAS, L. and AUGSTEIN, S., The Development of Reading as a Learning Skill (Brunel University, 1969), mimeo.


CHAPTER NINE

Non-linear Sequencing of Text Materials

1.1 Introduction

1.2 An Example of Non-Linear Materials
1.1 Introduction

In previous chapters, the emphasis has been on retrieval devices in text materials rather than on the text itself. This stemmed from the argument that the process of retrieval was relatively independent of the information being retrieved, and that descriptions of this process should not be confused with descriptions of particular kinds of information. Thus it is possible to construct a text with or without a retrieval system; this does not alter the content of the text.

Paradoxically, however, it can be argued that the more complete the system of retrieval used with a text, the more freedom the author has in the way he sequences the text. A hypothetical example will make this clearer. A text exists which is divided into five sections, and sequenced from 1 to 5. Using the retrieval system provided with it, an individual learner decides to tackle the text in a different sequence: 5,1,2,3,4, reading the last part first to give himself a grasp of the direction of the other chapters. If the text had been sequenced 5,1,2,3,4 in the first place, the reader would not have needed to use the retrieval devices provided. But another reader might have used the devices to sequence it in what was in fact the original order, 1,2,3,4,5, this
time reading the first chapter (5), last. It is conceivable that a teacher would assign different students to read in different orders. The point of this rather unlikely situation is that if the reader can reconstruct the 'logical' (i.e. writer's) sequence by using retrieval devices, the writer need not use that sequence in the first place.

It is likely that the writer will want to use the sequence he thinks is most logical i.e. most in accordance with the rules of sequencing he follows. But in fact, as Ausubel has pointed out, textbook writers tend to 'segregate topically homogeneous materials into separate chapters, and to present them throughout at a uniform level of conceptualization, in accordance with a logical outline of subject matter organization'. Ausubel is using 'logical' here in the semantic rather than psychological sense. He goes on to say that this semantic principle of sequencing can often be at odds with psychological principles:

This practice, of course, although logically sound is psychologically incongruous with the postulated process whereby meaningful learning occurs, i.e., with the hierarchical organization of cognitive structure in terms of progressive graduations of inclusiveness, and with the mechanism of accretion through a process of progressive differentiation of an undifferentiated field. Thus, in most instances students are required to learn the details of new and unfamiliar disciplines before they have acquired an adequate body of relevant subsumers at an appropriate level of inclusiveness.

What Ausubel is saying is that writers are confusing psychological rationales of sequencing with logical, or
semantic, rationales, and he implies that the latter should be abandoned in favour of the former. This point seems acceptable when it is remembered that by using retrieval devices, in particular the structural table, the learner can reconstruct the text in a semantically 'logical' sequence if he so wishes.

1.2 An example of a Non-linear Text

It was decided to explore Ausubel's idea by deliberately re-ordering or re-sequencing a text in what was thought to be a psychologically favourable order, and supplying retrieval devices which would allow the reader to reconstruct the original order if he desired to. The point of the exercise was not to suggest that existing texts could or should be re-arranged in this way; it is clearly more satisfactory if the text is sequenced according to consistent principles in the first place. The re-ordering exercise is artificial in this sense. The example is meant to show that alternative forms of sequencing do exist apart from the simple linear order. This particular form may not be an effective one, and is not put forward as a perfect example; but the general point can be made that writers of texts might consider alternative ways of sequencing the material they have.

The text chosen was two consecutive chapters from R. Prosser's book *Adult Education for Developing Countries*. The original version of these is given in Appendix A. The chapters, which come in a larger section of the book entitled 'Content and Method' have the following headings and sub-
headings in the text:

Chapter 12
Educational Radio and Television
  Radio
    Types of Programmes
    Radio Script Writing
    Listening groups and feedback
  Television
    Technical problems
    Teaching problems
    Organizational problems

Chapter 13
Correspondence, Educational Programming and Teaching Machines
  Adult Education by correspondence
  The advantages
  The disadvantages
  Organization and costs
  A general correspondence structure
  Course writing and student needs
  Programming and teaching machines
  Teaching machines

The subheadings, which are indented in the above list, come in the text at the head of the respective sections. It is thus clear to what subject each one belongs (e.g. technical problems ... of television). Each chapter has a short introductory section before going on to the first of the subheadings. It should be made clear that the decision to re-sequence this text is not a criticism of the existing arrangement which appears clear and well-ordered. Each of the main subjects (Radio, Television, Correspondence Education, Programming and Teaching Machines) is considered in
turn, and the clear headings provided make it easy for the reader to refer backwards and forwards as he wishes. The reader, one would suppose, would get a clear account of various aspects of each medium and technique. However, applying a slightly different rationale, it is arguable that such an arrangement emphasises the detail associated with each main subject at the expense of seeing them all together, and how they relate to one another. Arranged differently, the material might give the reader a clearer picture of the advantages and disadvantages of each medium without obscuring this with technical and organisational details.

Following this reasoning for the sake of the exercise, it was decided to re-order the text so that the sections dealing with the general aspects of each medium could be read consecutively, while the more detailed ones could be referred to, but not read in sequence. The text was thus organised in two 'layers'; the first layer, which is printed first, forms a consecutive text with headings in it; the second consists of discrete passages which are related to the first layer, but not necessarily to each other. The division into layers is as follows:

<table>
<thead>
<tr>
<th>First Layer</th>
<th>Second Layer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Educational radio and television</td>
<td>Types of programmes</td>
</tr>
<tr>
<td></td>
<td>Radio Script writing</td>
</tr>
<tr>
<td></td>
<td>Listening groups and feedback</td>
</tr>
<tr>
<td>2. Radio</td>
<td>Open and closed circuit television</td>
</tr>
<tr>
<td></td>
<td>Technical problems</td>
</tr>
<tr>
<td>3. Television</td>
<td>Teaching problems</td>
</tr>
</tbody>
</table>
4. Correspondence Education  
advantages and disadvantages

5. Programming and teaching machines

A number of small changes have been made; the division between the chapters has been eliminated as unnecessary, and new headings have been introduced for television and programming. Only minor changes have been made in the actual text. The sequencing and relationships between the various sections are shown in the sequence and structural tables provided at the beginning of the revised version (see below). The text begins with section 1 and continues along the first layer to section 5; after this the second layer begins with subsection 2.1 and the other subsections follow, each on a separate page, through to the end. To reconstruct the original order, the reader would have to read the subsections for each main section immediately after reading the main section. He would thus proceed from section 2 to subsections 2.1, 2.2, 2.3, then to section 3, and so on. References to the relevant subsections are given in the first layer, often at the end of sections, as follows:

(2.1 Open and Closed Circuit Television)  
(2.2 Technical Problems)  
(2.3 Teaching Problems)

The numbers of all sections and subsections are given at the top left-hand corner of the page.
Several points need to be made. First, a printed rather than a typed version is needed to do justice to this version, and improvements could be made in the actual format of the materials. However, the point being made here is simply that it is possible, using a coherent retrieval system, to sequence materials in ways other than a strict linear fashion.

Secondly, the criteria for arranging material in layers like this need to be carefully examined. It can be suggested that detailed, *tangential*, background or analogical material might be best placed outside the body of the main text. Tests and questions might also go there. But decisions like these must take into account the objectives of the text and the people for whom it is intended. No simple prescription can be given.

Thirdly, the example given here of a division into two layers is only one of a number of possibilities. The text might be divided into three, four or even more layers if it were thought necessary, going from a very brief overview of about a page as the first layer, through increasing detail and differentiation. The possibility of having texts sequenced in a non-linear way depends on a simple technical fact: that the reader can turn to any other page in the book almost as easily as he can turn to the next page or the previous one. To do this he must have a system of description and notation. Hence the existence of these devices allows the reader to use the full technical potential of the book.

A short introduction has been added, which explains the organisation of the text; this is followed by a sequence table and a structural table. Page numbers for the thesis
have been transferred to the bottom right-hand corner of
the page. There are a number of printing and grammatical
errors in the original text; except in the most obvious
cases, these have not been changed.
This text is about the new media in adult education: educational radio and television, correspondence education, and the revolutionary developments in programmed learning and teaching machines. The writer describes the advantages and disadvantages of each medium in turn, and gives some hints about organising and using them. He also discusses how they can be used together, in various combinations.

Before starting, you should look at the Sequence and Structural Tables on the next pages, which will give you an idea of the order and structure of the material.

The text is arranged in two layers, numbered 1 to 5, and 2.1 to 5.2. The first layer, which gives a more general view of the subject, can be read continuously, or in sections. The second layer, which covers more detailed points, can only be read in sections. You can refer from the first layer to the second one by using the headings at the end of each section.

The number for each section is in the right-hand margin; numbers in brackets indicate 'continued'.
SEQUENCE TABLE

1. Educational Radio and Television
2. Radio
3. Television
4. Correspondence Education
5. Programming and Teaching Machines

2.1 Types of programmes
2.2 Radio Script writing
2.3 Listening groups and feedback

3.1 Open and closed circuit television
3.2 Technical problems
3.3 Teaching problems

4.1 Organization and costs
4.2 Course writing and student needs

5.1 The elements of programming
5.2 Programmed books and teaching machines
One of the major problems which faces adult educationists in Africa is that of reaching the mass of the people. Africa is by no means, in comparison with other parts of the world, a densely populated continent. The areas are large and, with exceptions, the people are thinly spread over them. In urban areas it is possible to collect homogeneous adult groups together to make face-to-face teaching methods worthwhile and economic, although even in this situation the demand for education often outweighs the supply of adequately qualified teachers. But what of the rural areas over which the bulk of the population is scattered? Radio and television can help provide a solution. They can be used for teaching purposes in towns and cities, but they are often the only way in which adult teaching can be achieved in rural areas.

The full effect of teaching using radio and television in Africa is only gradually being realized. But these are the media which are becoming more and more popular in providing general educational opportunities and as familiarity with their use improves, new ways of using them are devised. It is possible that these media in the near future will take the brunt of the educational burden. It is because those working in adult education will find themselves using these media more and more that this chapter is justified. They will be responsible for devising programmes, for introducing programmes, for conducting programmes and, at the receiving end, controlling listening and viewing groups.

Along with the problem of providing for a scattered adult population is the problem which faces all developing countries; that of the shortage of trained and skilled teachers. Again radio and television provide the means which can help to overcome this. One good teacher can, through radio and television, teach at any one time many people scattered over the country, both children and adults. As there seems to be no likelihood of the teacher shortage solving itself, these media must be fully utilized.

It is true, and no doubt will remain true for some time, that radio and television coverage is limited. This is more so of television than radio. It is also true that costs of receiving equipment are high. Yet a growing number of African countries are providing television services and communal television sets. All have radio services and most adults have access to a radio set. Coverage is increasing all the time and, as good educational programmes are available, so the demand for them will grow.
The advantages of using radio as an educational medium include:

a. It can reach a wide audience, over as wide a distance as reception will allow.
b. It is economic for material can be prepared and recorded and used as many times as required. Thus repeats become cheap and possible.
c. Receiving sets are readily available and reasonably cheap.
d. The best teachers can be used with a very wide coverage.
e. The programmes can be heard inside the home if necessary, thus making them more convenient.
f. With the introduction of transistorized radios, sets are easily transportable.
g. Programmes can be used as complete teaching courses, or can be integrated into face-to-face teaching courses, or used in conjunction with correspondence courses.

But there are disadvantages and these must be considered by those responsible for planning and administration of programmes. They include:

a. Radio can be impersonal and students listening for long to a voice from a box can lose interest quickly.
b. There can normally be no student feedback which is spontaneous although the use of listening groups and correspondence courses can help to overcome this disadvantage.
c. Radio programmes can provide no visual help and therefore there is a limitation on the variety of subjects which can be taught.
d. Radio programme reception can be interrupted thus causing loss of continuity.
e. Lengthy regular radio programmes unsupported in other ways cause difficulties of self discipline amongst students.
f. Because radio programmes are beamed to a large audience and "anybody" may be listening in, there is often an initial reluctance on the part of tutors who have had little experience of the medium to commit themselves to the radio.

(2.1 Types of programmes) 
(2.2 Radio script writing) 
(2.3 Listening groups and feedback)
Television is proving to be one of the most versatile audio-visual aids ever developed. Educational television is a relatively new field of activity and there is still a great deal of experimentation to be done to develop its use to the full. Much of what has been written about radio applies equally well to television. Radio has many advantages as a medium of mass communication, but in some ways television has even more.

Television appeals to the eye as well as the ear. Therefore, a much wider range of subjects can be taught by radio and a wider range of teaching methods and aids can be used. Teaching by demonstration makes effective instruction in the applied and physical sciences possible. "Live" commentaries and the use of visual aids enlivens all teaching.

While much can be said for television, it is as well from the outset to bear in mind some of its deficiencies. It cannot do all. It can never replace face-to-face classroom teaching for it lacks the personal touch of teacher and students. The spontaneous friendly comment which stimulates and encourages the learning process in the classroom or group session is missing. The cut and thrust of quickfire questions and answers which makes good teaching cannot be reproduced. The pace of teaching is fixed and can proceed neither slower nor faster than the machine. Of course, some of these disadvantages are overcome when the television programme is supplemented by some face-to-face teaching and, as sometimes happens, are integrated into correspondence course instruction which also includes periods of face-to-face meetings.

There are wide varieties of instructional programmes which can be devised based on the use of different educational media including television.

In developing countries, the use of television can be a tremendous aid to the provision of adult education programmes. Yet care must be taken that a national television service does not become a mere status symbol as a sign of national development, without due regard to quality of programme. The influx of cheap poor quality entertainment programmes of a strictly commercial nature is to be regretted when it is allowed to the extent of taking up viewing time which could be used for more constructive purposes.
The costs of providing television services are high, the costs of receiving sets to viewers are high, therefore to be economic there must be a mass student audience. With a large enough student body, television education is economic. It has been proved so many times. But because large numbers and large areas are involved, organizational problems are correspondingly large.

Television in its most effective usage entails a complexity of relationships: its integration with other media, the broadcaster and viewers, the technicians and teachers. To make full use of television services requires a national organizational structure which brings together technicians, teachers and administrators. As a separate chapter has been devoted to general organizational problems, it is sufficient here to provide a cautionary word and to emphasize the need for such an organization, before television on an open circuit can be made to play an economic role in the provision of adult education, for it is an expensive medium to play with.

Television has a major role to play in all fields of adult education. In formal adult education integrated with correspondence courses and classroom teaching, it can bring the best teachers into contact with adult students and provide a major breakthrough, where national school systems leave a large uncatered-for youth and adult strata. In fundamental adult education, television can teach literacy and teach non-readers useful information in the fields of agriculture, health and child care amongst other subjects. In liberal adult education, through discussion programmes, news items and general courses, it is a stimulating aid to developing a thinking and discriminating adult community. In developing countries, it must be used.

(3.1 Open and Closed circuit television)

(3.2 Technical Problems)

(3.3 Teaching Problems)
CORRESPONDENCE EDUCATION

One advantage of late development is that the newcomer can make immediate use of the latest knowledge, techniques and devices made known by others without having to go through the laborious and expensive processes of trial and error and experimentation. Developing nations just beginning to grapple with the problems of large scale adult education provision can similarly take advantage of new methods and skills devised elsewhere in the field of adult education.

Adult education by correspondence is not only new to the world, but it is relatively new as a home grown form to the African continent. The value of such an educational method is being rapidly appreciated and is taking on a new importance. Adult educators must be prepared to take part in such developments and must, therefore, acquaint themselves with the details of the skills and disciplines associated with this method and which are basic to their successful implementation.

Education by correspondence making home study possible has been impressively developed in such diverse parts of the world as America and Canada, Australia, New Zealand and Scandinavia. In Africa, the educational traditions of the ex-colonial powers did nothing to encourage the growth of this type of educational method. It is only in recent years, that new national governments have made any significant attempts to remedy this situation and as part of government policy to use it as an effective weapon in providing mass education.

Yet it would be wrong to assume that there has been no education by correspondence. Commercial correspondence schools have been active for many years and these, for many adults, have provided the only opportunities for educational advancement. Most commercial correspondence schools have been based overseas but a few are local. As in any other field of commercial education, some schools give value for money, others do not. However, such is the scale of educational need that it is now becoming impossible for ministries of education, universities and other public bodies of adult education to avoid involvement in the provision of correspondence education and to provide courses on a non-profit making basis.
Correspondence courses can be evaluated in their own right or they can be considered as an integrated element of an instructing system involving their use alongside other teaching methods. Thus, they can bear the complete teaching responsibility for certain types of courses, or integrated with radio or television courses, residential courses or part-time face-to-face classes, they can bear partial responsibility for many other varieties of instructional courses.

They have a number of advantages:

a. They can provide a cheap but practical way of educating a wide range of adults who cannot attend, or do not have the opportunity of attending, regular classes.

b. They can provide effective teaching in a wide range of subjects especially in the formal arts field and, with the integration of periods of student residence, a limitless range of subjects.

c. Their instruction is individual, teacher to student, and each student can move at his own pace.

d. They can provide thorough teaching in that the student moves systematically through a field of study going on to new material only when the previous is mastered.

e. They can provide the best teaching material to a wide range of students since quality control is centralised.

f. Courses can begin at any time; there is no need to wait for new terms except where supervised group meetings are an integrated part of the course.

g. They allow education to continue while adults are working and earning, thus in no way interfering with individual incomes and national efficiency.

There are disadvantages as well:

a. In subjects requiring a large degree of group participation or demonstration, unless taught in conjunction with other teaching forms, they cannot be fully effective.

b. They require students who have a great enthusiasm for learning, since the self-discipline required to carry through a correspondence course to successful completion is great.

c. They require an efficient postal system with as close a network of mail receiving and distributing centres as possible.

d. They require a high degree of organization to maintain high standards in the preparation of material, in the controlling of finance, on the efficient distribution and collection of work assignments and in marking. Where other media are involved as well, an even higher degree of organization is necessary though not unattainable.
The use of programming alongside the development of teaching machines is comparatively new to the world. Both programming and teaching machines are on the frontiers of the development of a new educational technology with prospects of revolutionary conventional educational methods. Adult educators must be aware of them and be in a position to assess their importance and make use of them, adapting to local requirements as circumstances permit. The development of these devices is still in the experimental stage but results are proving encouraging and there is every likelihood that in the near future both the technique and the machines will become widespread.

Programmed learning or more grandly, auto-instructional materials as it is sometimes called, has grown up with the development of psychology and it has been applied to education and the process of learning. Most educators agree that the basic principles of learning are:

- **a.** When a student learns, he learns for himself. A teacher may stimulate him to learn and provide with materials but it is the student who does the job.
- **b.** The rate at which a student learns varies considerably, and students learn best at their own pace.
- **c.** Complete mastery of each step makes total learning more effective.
- **d.** A student learns more when each step is underlined.
- **e.** When a student learns on his own, he is likely to learn more.
- **f.** Whatever a student has to learn should be appropriate to his background, and easily related by him to it.

Good programming is based on these principles, emphasizing each principle as much as possible.
Teaching machines vary from programmed text books to complex and expensive electric computers. They are used in conjunction with courses of programmed learning and naturally it is the quality of the programmed material which is basic to the success of the machine. The advantages of such machines are fourfold:

a. They allow the student to work alone.
b. They make sure that the student understands each unit of information before he is allowed to proceed to the next.
c. They present only one unit of information at a time, and the student proceeds at his own pace.
d. They help the student to maintain interest by making him respond and presenting him immediately with the correct response.

(5.2 Programmed books and teaching machines)

This brief and inadequate introduction to programming and the use of teaching machines is meant to indicate to the adult educator the basic rudiments of a new educational technology. There is no doubt that in a situation where there is a chronic shortage of teachers and insufficient and poor resources and facilities, it has much to offer and can play a great part in improving the quantity of all forms of adult education in the developing areas of the world. Its use should not be devoted solely to child education and need not be a monopoly of those countries where it has originated. Good programming requires skill in presentation as well as a thorough knowledge of subject materials; it is based on the learning processes of those students for whom it is intended; cheap machines can be devised to suit local needs. Adult Educators in Africa, who know Africa, are the ones who can best produce materials for Africa. They must enter this technological field.
TYPES OF PROGRAMMES

It is useful to distinguish two different types of educational broadcasts. The first type includes the general interest programme which is beamed out at the general public. These would include news items and commentaries and programmes which have an entertainment content which is more important than the actual educational content, e.g. discussion, quizzes, forums. The second type is the educational broadcast of a high educational content which is beamed at a specific audience. These include schools broadcasts for children and broadcasts for farmers, school teachers, engineers or any otherspecific group. These programmes, while being mainly for educational purposes may also entertain and should do so for best effect.

The general interest programme involves problems of planning, content and evaluation. Experience and listener surveys are two ways in which a guide can be found to the most popular types of general interest programmes. Experimentation with new ideas involves a certain amount of risk which must be carried out if new forms are to be popularized. Evaluation is difficult since there is generally no feedback and the only guides are periodic listener surveys which assess popularity of programmes.

Strictly educational broadcasts can be used in all forms of adult education. As has been suggested, their use in developing countries is one of the few ways in which any real impact can be made on their large scale problem of adult educational provision. Educational broadcasts cannot stand on their own. But they can be usefully integrated into correspondence courses and regular class meetings.

Correspondence courses alone are very impersonal and for successful completion require a high degree of self-discipline. Regular radio broadcasts can inject a more human element and provide a stimulus to regular student study when built into a correspondence instructional system.

In rural areas especially, regular and frequent face-to-face classes are difficult to organize through lack of teachers and the often thin scatter of students for higher level classes. Regular monthly weekend sessions may be all that can be programmed realistically. However, educational radio broadcasts can again be used providing continuity through the long periods when teacher and student cannot meet, with the added advantage of the best radio teachers being used.

Radio-vision — the use of radio with coloured filmstrips — is less effective than television, but nevertheless it provides a novel way of enlivening an educational broadcast and has proved attractive as a teaching method.
Many teachers of adults who are perfectly happy in a classroom hesitate before committing themselves to a radio broadcast. Radio broadcasting is an art and each broadcaster will use the medium as it best suits his personality. Nevertheless there are a few guides which can help the new broadcaster and which he can use as a prop for his confidence. The following are a few which may help:

a. Never forget that any radio talk is for the ear and not the eye.

b. Remember that material must interest before it will educate so dress any talk in as interesting a manner as possible.

c. The audience is ONE person only and, as in all adult education, never talk down to the listener—talk to him.

d. Do not try to teach too much at one go, concentrate on one or two major points and see that they are driven home in the most effective way. In formal subject lessons tell the student what you are going to say; say it and then tell him what you have said.

e. Make your delivery as personal as possible; write the script as you would say it; use shortened forms of words such as "shouldn't" instead of "should not"; use the active voice not passive, emphasize important words in the script.

f. Do not mind what the script looks like, it is the sound that matters.

g. Where there are listening groups, encourage them to take part, give very short questions which can be answered on the spot.

h. When quoting figures, round them off unless exact figures are absolutely necessary. In the latter case they should be repeated. Similarly avoid lists. They are difficult, if not impossible, to assimilate by ear.

i. When the script is finished polish it up. Change dull words for more vivid and descriptive ones. Watch for word sounds which slur into each other when spoken and thus make comprehension difficult.

j. Time the script carefully and have a definite conclusion. Your speed of delivery should suit the audience to whom you are talking. Anything from 100 to 150 words a minute should provide a reasonable range guide.
LISTENING GROUPS AND FEEDBACK

Formal adult educational broadcasts will be beamed at a specific section of the adult community. In order to make the teaching more effective and provide a guide to student progress, as well as creating a means of teaching evaluation, some sort of student organization is required. The formation of listening groups is a way in which students can be brought together. The group can have a properly qualified teacher to amplify the radio teaching. If such a teacher is not available then a group leader who can conduct discussion and channel correspondence between the broadcasting agency and the students could be obtained.

Listening groups provide a number of elements which are often essential to making the best use of broadcast programmes:

- they make possible the use of communal radio sets where such sets are not available to all students;
- they enhance and provide an extra self-disciplinary aid to students studying privately and individually.

The group meeting can itself encourage student application from its social nature;

- they encourage the exchange of ideas on the teaching content between students and provide opportunities for face-to-face teaching if there is a teacher available.
- Difficulties can be cleared up easily and the subject or topic of the broadcast developed further within the group.

More important, they provide a way of evaluating the broadcast courses from the feedback from individual students and teachers or group leaders. General comments sent in, questionnaires and problem-answer papers submitted will allow the Radio teacher to know how successful he is, and indicate ways in which he can improve his performance. A national structure of viewing groups will give a guide to national response and provide an organizational framework through which teaching materials can be distributed, new programmes advertised and written work marked and assessed.
Open circuit television is the kind of television which brings the normal daily programme. Anyone within the area of the waves, with a standard receiving set, can normally tune in to the broadcasts. It will generally be on open circuit television that mass adult education programmes will be presented, since it has a wide coverage. Programmes may range from strict entertainment, through a mixture of education and entertainment, to programmes mainly intended for educational purposes. As far as adults are concerned, it is unfortunate that the most convenient times for adult educational broadcasts correspond with the times for peak entertainment demands - evenings and weekends. Even so, there is much that can be achieved if adult education time is allotted in the early evenings and Sunday mornings when demand for pure entertainment is likely to be lower. Of course, no problem arises when a separate channel can be devoted entirely to educational purposes.

Closed circuit television provides broadcasts to a limited area in such a way that conventional receiving sets cannot pick up the programmes. The term may apply to anything from small inter-classroom systems embracing a number of schools or buildings in an area. Closed circuit television is cheaper than open circuit variety and can be privately devised. It is useful in relaying programmes, economically, within a small area.
Television is a technical medium; skilled direction, the production of competent camera work and precision timing are but three key factors in obtaining the best presentation. Most teachers will not have the knowledge and skills necessary and they will need the help of an experienced television director in the production of the programme. Successful programmes will be those which have a maximum of mutual understanding between the teacher and the director. The director must be able to communicate his understanding of the ways and methods of television to the teacher. However, he must also understand the problems of the teacher in organizing subject matter and keeping the students' interest. It is advantageous if the programme director has previously been a teacher himself, and the more teachers who are trained in the intricacies of the mechanics of television production, the better.

At the very early stages of planning an educational television series, it is essential that teacher and director get together, so that the programmes can be devised jointly and with harmony.
Once the subject has been settled and the limits set, the number of individual programmes in the series can be worked out and the topics assigned to each.

Points to remember in the preparation of individual programmes on the transmitting side are:

a. Television is a visual medium. If a programme does not have a strong visual appeal, it should be produced over radio.

b. Everything that goes before the television must be planned.

c. Use, whenever possible, simple non-technical language and to speak normally. Correct mistakes without undue worry and with grace. Mistakes will occur.

d. Do not overdo visual aids, the skilled teacher will use them as an aid and not as an end in themselves.

e. Keep persons involved in any one broadcast to a minimum.

f. In general, it is better not to have a script. An outline of sequences of events and cues is often sufficient, and dialogue can be improvised. Programmes should be rehearsed but again it is only necessary to fix the sequence of events and cues.

g. Marshall all the necessary visual aids well before the programme begins.

h. In timing, it is better to finish a little early than rush the last few minutes.

i. Plan well ahead and keep programmes in hand to avoid last minute rushes.

Points to remember on the receiving side for those working with viewing groups:

A. Prepare the room thoroughly, check lighting, ventilation, seating and the position and efficiency of the machine.

B. Prepare the student for the programme. The student should be fully aware of what the programme is about and why it is being viewed.

C. Encourage students, if necessary, to take notes whilst the programme is running but see that they are kept brief so that the student does not miss important parts of the programme.
D. Be as prepared as you can for technical breakdowns and bad reception. These do happen. Have something in reserve.

E. Follow-up is important. Discuss the programme with the students, explain difficult points, elaborate where necessary and summarize.
The two major functions which the organization will serve, will be administrative and academic.

The administrative functions will include: the development of routines for publicity, fee collection and enrolment of students, duplication of materials, despatch of materials, collection of completed assignments, distribution to and collection of assignments from markers, return of marked assignments to students, maintenance of student records, general costings, and the general student advisory service.

The academic functions will include policy-making on the types of courses to be prepared, preparation and renewal of courses, preparation of ancillary services, i.e. textbooks and book lists, planning of any integration with other teaching forms such as radio/television, residential courses, etc.

Top management will, of course, combine the chief administrative and academic functions and will be responsible for policy-making and liaison with other national planning bodies to ensure maximum co-ordination within the general scheme of provisioning for national needs. This means that the director of a correspondence unit must be both a tutor and an administrator.
Any correspondence course will only be as good as the material in it. The writing of a course will require careful thought and preparation. Classroom teaching allows for margins of incoincidenceness and wandering; a correspondence course does not. The writer must be an expert in his subject but must also be an expert on learning methods. He must understand how a student learns on his own. He must understand the nature of the general student who is to use his material. He must, from the outset, clearly define his objectives, only then can he decide on the relevancy of the material he will use. The arrangement of the material, the inclusion of illustrations and the illustrations and the preparation of written work must be devised to make learning as easy as possible for the student, and written and presented in such a way that the students' interest is maintained throughout.

Skill in writing correspondence courses will come with practice and the completion of a course should never mark the end. Constant revision will be required to keep the material up to date, to improve presentation and to ensure that only the best is provided. Only the best is good enough for students who have the courage to study on their own.

Organizations offering correspondence courses, whether commercial or non-profit making have a special responsibility towards their potential students. Besides offering only the best they must be sure that the student is ready for the course. The student must have sufficient educational background to be able to benefit from the course. He must have the necessary ability to do the work properly. He must have sufficient incentive and self-discipline to complete the course. He must be prepared to set aside enough time to study properly.

In developing countries, such is often the thirst for education and so few the opportunities that the correspondence school is never short of students. Where such a situation exists the unscrupulous will move in. Adult educators must be in a position to advise potential adult students of the best schools which can meet their needs; they must also be able to advise them against the worst.
Programming means, basically, breaking down subject matter into small units of information which are then arranged in logical sequence. The student works through the subject matter, unit by unit, on his own. The units of information, or frames, are presented in problem form and the student does not move from one unit to the next without first having arrived at the correct answer. In this way, at every step, his learning is underlined or reinforced. Depending on the design of the programme, problems usually require either filling in a blank space to complete a sentence or choosing the correct answer from a group of possible answers. Problems are not designed to catch the student out, but are rather designed to make it easy as possible for him to get the correct answer; and a number of clues are often included in the information to achieve just this.

A simple example of two frames which could be taken from a programmed course in economics runs as follows:

a. When the price of a commodity rises we expect the quantity demanded to fall. When the price of a commodity falls we expect the quantity demanded to ......

b. If the proportionate increase in the amount demanded of a commodity is less than the proportionate increase in its price we say that the demand for that commodity is inelastic. If the proportionate increase in the amount demanded is greater than the proportionate increase in price we say that its demand is .........

The response to frame (a) is clearly "rise", to frame (b) "elastic".

Cues are obvious in both frames and it is made as easy as possible for the student to reach the correct answer. He will learn as he is responding and making a correct response will reinforce his learning. Answers are provided and the student checks himself, before moving to the next frame.

This type is called Linear Programming since the flow of information and frames moves directly forward in a straight line.

Diagrammatic Representation of Linear Programming.
A second type of programming is called Branch Programming which has more flexibility than linear programming in that the material can adjust itself to the student's response. The same pattern of unit frames is used for both, but in branch programming multiple choice questions are offered. If the student chooses a wrong answer then he is told that he is wrong and may be directed through a new remedial sequence of frames before rejoining the main sequence.

Branch programming has the advantage that the quicker student can proceed without losing interest, and the slower students who are prone to mistakes can be led off on branches, where they will be provided with more fundamental and simple instruction. One argument against the use of branch programming, or rather against multiple choice test questions, is that presenting a correct answer amongst a number of wrong answers may cause the student to remember a wrong answer which might otherwise not have occurred to him.

Diagrammatic Representation of Branch Programming.
PROGRAMMED BOOKS AND TEACHING MACHINES

The simplest teaching machine is the programmed book. The book presents programmed subject matter in generally a linear or a simple branched flow. After responding to a frame, the student is directed to another page for the correct response, or he may have the correct response indicated by the side of the following frame which he will be expected to keep covered until he has answered. Of course, this type of book may tempt students to cheat which is not generally possible with mechanical teaching machines. Nevertheless, well constructed programmed books can be a great help to a student studying by himself who is prepared to use them correctly.

The simplest mechanical teaching machine has the programmed material in reel or disc form, placed in the machine with one frame appearing through a window in the machine. A separate window exposes a space for the student to make his response. After making his response, the student turns a handle which produces the next frame and the correct response. At the same time, his own response will have moved on under a transparent cover which allows him to check his response against the correct one but does not allow him to make any alterations. In this way, he moves through the complete programme. When he has finished, he will repeat it, but a simple mechanical device will cause the machine to present only those frames to which he gave an incorrect response.

Complicated electrically operated machines allow for great flexibility and can present linear or branched sequences with multiple choice questions. They are expensive and their development is still largely experimental.
References to Chapter Nine


2. ibid.


4. ibid., pp.110-129.
CHAPTER TEN

CONCLUSION

1.1 Textbooks as Information Stores: A Summary of the study.
1.2 Textbooks as Information Stores: Suggestions for research and development.

2.1 Information Subsystems and the Instructional System.
2.2 The Uses of Analogies.
CHAPTER TEN

CONCLUSION

Since this thesis has dealt with both the general subject of instructional systems in adult education, and the specific problem of the design of textbooks as information subsystems, the conclusion will be divided into two sections, as follows:

1) The design of textbooks as information stores; suggestions for further research and development.
2) Information subsystems and instructional systems; general considerations.

1.1 Textbooks as Information Stores: a summary of the study

The research on the design and use of textbooks as information stores was reviewed and analysed in Chapter Four. Three experiments were reported\(^1,2,3\); of these, the latest, conducted by Horn\(^4\) was the most extensive, and closest to the line of enquiry pursued in this study. It was suggested that the first two experiments were both too limited in scope, and too inadequately conceptualised to provide useful guidance for this investigation. In both cases, the texts were shorter than 4000 words, and it was suggested that the lower limit at which a retrieval system becomes useful may be higher than this. In neither of the first two experiments were the devices in question referred to as retrieval devices, and in one of them\(^5\) there appeared
to be no distinction drawn between devices which organise or control the learner, and devices which facilitate organisation or control by the learner. This distinction is also missing in Horn's work, with the rationale for the design of information maps drawn both from previous work by Ausubel on organisers and more general references to information retrieval and reference. It has been argued that at least for purposes of research, a distinction must be made between controlling the learner through organisational devices like overviews and questions, and facilitating control by the learner through the provision of retrieval devices. Although Horn's work has useful features, some of which have been reported in Chapter Seven, it does not appear to be clearly conceptualised: the fact that he uses the terms 'learning and reference' in connexion with information mapping suggests that the implications of the word 'reference' may be similar to Lumadaine's use of the word: as something to be distinguished from learning or instruction. This distinction was examined at some length in the third chapter, and it was concluded that the process of information retrieval could be seen as one communication mode among others, and that it was as likely to occur in instruction as other communication modes. Compared with both the presentation and interactive modes, the retrieval or search mode permits a high degree of learner control. The review of research on learner control of sequencing was inconclusive, but suggested that this was an aspect of adult learning that might justify further investig-
ation, particularly in the light of early work by Mager. It was pointed out that the provision of retrieval devices in a linear text gives the learner the option of exercising control, but does not preclude the choice of the source-controlled sequence. An analysis of examples of devices taken from current textbooks showed considerable variety in the design of devices, but no evidence that the books in question had been consciously organised to facilitate retrieval.

In the light of both the paucity of research in this area, and the unsystematic design of textbooks as information stores, the following suggestions for research and development are put forward.

1.2 Textbooks as Information Stores: Suggestions for Research and Development.

A framework for the design of a retrieval system in textbooks was elaborated in Chapter Six. In this, each device was assigned a specific function, and an overall plan of devices was suggested. This framework could be used in the design of retrieval devices for experimental testing. There are four main variables in the retrieval situation:

1) The task definition and method of assessment.
2) The learner.
3) The information in the store.
4) The retrieval system.
It is suggested that a series of experiments could be conducted which would test the effectiveness of various retrieval systems in a number of situations. That is to say, different arrangements of retrieval devices could be tested where the task definition, the learner and the information are held constant; or a particular retrieval system could be tested in relation to different task specifications, different learners and different types of content. In the task specification, the form of assessment might be varied to include objective-type questions, summaries and essay-type questions, with varying emphasis on recall or integration of information. In the learner, age, personality and previous knowledge of the subject and of retrieval techniques might be relevant variables. As regards the information or content, texts on different subjects and with differing structures might be used. The notion of structure has already been examined in Chapter Eight; although there are difficulties with the subjectivity of this concept, it may be a significant variable in relation to retrieval. It is to be expected that retrieval devices will be of more use where the structure of the text departs from the serial order imposed by the book format. Richards, in Chapter Seven, was aware of a mismatch of this kind in his own book. Finally, in the retrieval system, there is a considerable range of devices which could be tested individually or in different combinations. This might take the form of comparisons between versions of a text which have increasing numbers of devices, in the following form:
In view of what has been written about the organisation of devices as a system in Chapter Six, it might be expected that merely to add more devices without taking care to integrate them with existing devices would achieve little.

Within the broad outlines given above, it is suggested that the following hypotheses in particular might be tested:

1) The provision of retrieval devices in a text will lead to an increased use of search strategies in a given group.

A group of adult learners could be presented with a number of texts which have few or no retrieval devices. From an observation of their reading strategies, it would be possible to see how many members of the group habitually adopted single-read or search strategies. The same group could then be presented with another text which contained a complete retrieval system, and their reading strategies again observed. If the number of people in the group who adopted search strategies increased significantly, the difference could be attributed to the retrieval devices. The experiment could be repeated with or without coaching in the use of retrieval devices.
2) The use of retrieval devices is greatest when the task involves organisation and integration of information contained in the text.

Two groups of learners might be presented with identical versions of a same text, but given different task specifications; one involving simple recall of information, the other specifying the ability to summarise or otherwise integrate the information. An observation of the reading strategies of both groups would show to what extent the devices had been used. It is to be expected that the second group will make more use of the retrieval devices.

3) Learners with certain types of personalities use retrieval devices more than others. This has been suggested by an experiment by Leith and Trown which showed that introverted students preferred a structured learning situation, whereas extroverted students preferred an unstructured one. It can be hypothesized that learners who prefer a structured situation, will prefer to follow the linear sequence, and that learners who like an unstructured situation will use retrieval devices to move around in the material. This involves presenting learners with the choice of either following the linear sequence or using a search mode, and correlating reading strategies with personality profiles.

4) Learners with considerable previous knowledge of a subject use retrieval devices more than learners who know little about it.
Existing knowledge of a particular topic could be measured on a pre-test. A short text, dealing with that subject, could then be presented to a number of adult learners. It is hypothesised that the learners who score well on the pre-test will use the retrieval device to omit material they already know, and concentrate on what they want to find out, whereas learners who score badly will tend to follow the linear sequence.

3) The provision of retrieval devices in a text will increase learning measured as the mean of the group, subject to the following conditions:
   i) The devices are organised as a system.
   ii) The learners have been coached on both linear and search reading strategies and the option has been pointed out.

This experiment would have to be carefully designed to control other variables. Two groups of learners, matched as regards ability, could be presented with two versions of the same text, the versions differing only in the provision of retrieval devices. Both groups would have to have been coached previously on reading strategies. Gain scores as between pretests and posttests could be measured, and any difference between the groups attributed to the presence or absence of retrieval devices. The retrieval devices used in the experiment would have to be developed and tried out with other learners previously, and the coaching procedures also developed from previous tests.
The detailed design of the experiments outlined above cannot be attempted here. These suggestions are meant to point to certain elements in the retrieval situation which appear, from the foregoing study, to be worth investigating. In addition, three points can be made.

Campbell noted that coaching may be a significant factor. Since educational tradition lies, if anything, on the side of strict linear reading, it can be expected that something more than simply telling students about other strategies is needed. It might be possible to construct texts which would force the learner to search, by deliberately not providing a linear sequence; these could be used to train learners in search strategies. After this training, they could then be presented with the option of a linear sequence or a search mode, and their strategies observed.

Secondly, although this investigation has been entirely in terms of print and textbooks, there is no long-term reason for confining this to the print medium. At present, textbooks appear to be the best example of an educational device which allows the choice of source-controlled or learner-controlled sequencing. If audio and video cassette players become widely available, and adequate retrieval devices are provided, there is no reason why similar tests could not be run using them instead of textbooks. It is not expected that the medium would make any difference, since the significant factor is not in the medium, but in the locus of control.

Thirdly, the implications of these experiments may extend
to collections of materials, as well as single textbooks. In this respect, the problems of retrieval which occur with the single text are a microcosm of the larger-scale problems which arise with materials stored in resource centres or learning centres. It may be that some of the devices discussed here, like the introduction, the structural table and the cross-reference could have their counterpart at library level, in the form of specially written guides to materials. These might provide more detailed assistance to the learner than the present catalogues, indexes and booklists do. Access to materials is not simply a matter of being able to take a book off a shelf; the process of matching is as central to the use of resource centres as it is to the use of single books. If independent study is to be a central feature of adult education, then attention has to be paid to the organisation of materials for student access and to the training of students in the techniques of retrieving and organising information.

In addition to the experimental work described above, more informal, developmental work on the design of retrieval devices could be carried on. There appear to be two main needs in this respect. The first is to have some general awareness of the problems involved so that in the design of new books, some basic standards can be assured. These depend mainly on common sense. It seems obvious that if there is going to be a table of contents at all, it should give more information than is given, for example, by Whitworth.
that the headings used in it should be reasonably comprehensible to the new reader; and that the headings in it and the text should be consistent. Similarly, more care should be taken with format, to ensure that major divisions in the text are clearly marked and headings stand out. An awareness of the problems of retrieval could bring such piecemeal improvements.

There is also room for developmental work on new devices such as structural tables, re-ordered texts and co-ordinate indexes in the texts. Tryouts of material incorporating these could provide useful information for the subsequent design of these devices for testing. Observation of students' use of these devices, and interviews in which the students' impressions of them are sought, might avoid some basic flaws and suggest new possibilities. It is felt that these ideas are still at a rudimentary stage, and not yet ready for rigorous testing. Development of them need not be left to educational researchers; teachers and publishers could work on their own.

Both research and development in this area depend on a conceptual framework which identifies a problem or problems to be solved. The problem, in turn, depends on a possibility and a choice; and it is this choice, between using texts serially and using them selectively, which does not seem to have been recognised. If the validity of the distinction between a presentation mode and a search mode, with differing degrees of source and learner control, is accepted, then the research strategy appears to be relatively clear. This thesis
has concentrated on this theoretical point, because the inadequacy of previous research and lack of perception of the problem which appears in the literature seems to stem from a theoretical confusion surrounding the terms 'information' and 'reference'. This raises again the question of the definition of information and of the role of information subsystems in the instructional design.

2.1 Information Subsystems and the Instructional System

On a theoretical level, the information subsystem and the instructional system modify each other.

The inclusion of an information subsystem necessitates what has been called here a 'devolved' model of the instructional system, in which the relationship between the subsystems and the system may vary. In some cases, the subsystems may be centrally designed and controlled; in others local control may be given to the contact teacher, the producer of materials, or to the learner, as in this case. Instead of there being centralised and detailed control, there is a hierarchy of controls within which subsystems may have a considerable degree of freedom. This is freedom in terms of the system as a whole, but not anarchy, because each subsystem has its own locus of control, which is finally responsible to the next level up in the hierarchy. In practical terms, this means that instead of attempting to design in detail all the elements of a course, the course designer should ensure
that a) the teachers and learners in the course have the ability to control certain parts of the course, and b) there is an adequate means of keeping a check on the progress of the teachers and learners. In terms of the adult learner, this implies that first, he should be taught how to manage his own learning and that secondly, some means of monitoring his progress is available to the adult teacher. In order to manage his own learning, the adult needs techniques for analysing and formulating objectives; for gathering and interpreting feedback and for developing alternative strategies of study which he can adopt as the need arises. It is not suggested that all subsystems should be locally-controlled but that alternatives to monolithic system models should be considered. Seen in this context, the process of retrieval is not simply a means of manipulating information to save time and effort, but a paradigm of learner-controlled instruction. Mager can be quoted again:

Perhaps it would be as useful to give the student powerful techniques for effective inquiry, and substantial control over his learning activities, as to give programmers effective techniques for programming. Perhaps by the process of providing the student with tools that will give him confidence in attacking any new learning problem, we could — even — come closer to realizing the goal of making learning a lifelong interest.

However, the context of the instructional system means that the notion of learner control is in itself subject to some controls, and it is in this way that the system modifies the subsystem. In the first place, the learner-controlled subsystem does not exist in isolation; there will be a larger
constraint which will attempt to ensure that the subsystem does not upset the rest of the system, either by falling short of its goals, or by generating its own incompatible goals. Secondly, a learner-controlled subsystem implies that the development of learner independence in certain respects is compatible with the overall aims of the course.

More broadly, the systems context provides not only constraints of the type mentioned here, but safeguards against the kinds of imprecise analogies which were examined in the first chapter. There, they were analogies from mass communication and entertainment. A recent editorial in Audiovisual Instruction suggests that the burgeoning information technology outside education may be a newer source.

The learning process is increasingly conditioned by the management of information — our primary professional concern. In our major graduate centres we have been expounding this philosophy throughout the Sixties. It is now time to consolidate the gains we have made in this direction and give new educationists, whom we have spawned, an opportunity to influence the future activities of our field.

I suspect there is no such thing as a knowledge explosion; at least not in the proportions or to the same extent as the tremendous information explosion which overwhelms us. Information is growing at a phenomenal rate. For instance, isn't it odd that the largest corporate giant in the world (International Telephone and Telegraph Company) is a mover of information — that it does not sell a specific hardware product? No one can argue with the evidences of growth of IT & T; and it is quite candid about its function — it moves information. Indeed, collecting, sorting, analysing and deriving knowledge from information is the occupation of most employed adults in America.
The same process of argument that appeared in connexion with the mass media outside and inside education can be observed here. The common element — information — is emphasised. It is said to be the 'primary professional concern' of educators, and it is argued that information handling is the occupation of the majority of adults. Reference is made to the 'information explosion' and to a large corporation which is 'a mover of information'. The differences between the educational context and the wider social context are glossed over. It is not clear, for example, what the 'philosophy' referred to in the third line is; or what the exact distinction between knowledge and information is. To describe the occupations of most adult Americans simply in terms of information handling is to oversimplify the matter. Finally, it is not quite clear what the author is arguing; he appears to be suggesting that since information handling is a major activity in adult working life, the management of information should be the prime concern of educators.

Several points can be made in connexion with this passage. First, in any discussion of information systems, it is necessary to specify the purpose and context of the system. An information system is a means to an end; the end may be better decision-making, a saving of time and money, or the acquisition of knowledge. An information system in education exists within a larger framework of objectives and other, related means; if, as the above passage suggests, the 'management of information' is the main concern of teachers,
the objectives of this must be specified. There are thus two questions to be considered: the broad implications, for education and training, of the information explosion outside education; and secondly, the role of information systems as an element in instruction. These two questions cannot be run together; information handling in business and commerce cannot provide a direct rationale for the design and use of information subsystems in education.

A second point which can be raised is the degree of emphasis on any one part of the information process. In the past, because of the scarcity of means of storing information, storage received a great deal of attention. It was important to preserve books carefully in libraries, since copies were rare and difficult to obtain. With the advent of cheap printing and computer storage, this problem has become much less acute, and the main emphasis in the passage above is on the movement, or dissemination of information. Within this new emphasis on the movement of information, attention can be focussed either on the sending of information or the receipt or retrieval. The media of mass communication are primarily concerned with transmission; they obtain relatively little feedback about reception. In contrast this study has been almost entirely concerned with retrieval and reception. If it is accepted that the movement rather than storage of information is the main problem nowadays, care must be taken that the whole emphasis is not placed on transmission at the expense of reception. The use of the mass media to move information to people is at best an incomplete
analogy for education and learning; if learning is to take place, the conditions at the receiver's end need to be examined.

2.2 The Uses of Analogies

The above passage exemplifies a problem which has been continually arising in this thesis. This is the question of the extent to which education and instruction can usefully transfer or adopt models and terms from areas outside itself. In this sense, education seems to be a porous discipline since, as Reeves notes, the adoption of outside models was a feature long before the discussion of management and industrial plant models in recent years.

The arguments for the use of media in education which were examined in the first and second chapters of this thesis depended on a transfer of assumptions from mass communication and entertainment to education; it was argued that since the media were effective in informing and entertaining the public, they could be equally effective in educating people. This argument came up against opposition from another set of assumptions about the role of the teacher in education, which asserts that personal contact between teacher and learner is necessary for learning to take place. The importance of apprenticeship in the guild model of education which Reeves notes, may be one source of this assumption.
A more localised case of transfer occurred in Lumadaine's distinction between instruction and information, using information in a sense that fits certain contexts, like tourism, but which is not necessarily applicable to education. In place of this use of the word, it was suggested in the third chapter that an analysis of the information retrieval process — again coming from a non-educational context — provides a useful model for understanding the management of information in education. This involved taking terms like 'query', 'classify' and 'matching' from their information contexts and re-interpreting them in an instructional one. Underlying the whole approach to the design and development of instructional systems, is the assumption that education can be usefully regarded as 'technology', in the sense that systematic study of the process of instruction is possible.

It has not been possible here to examine each of these transfers of terms and models in detail. Some of them, like the use of the word 'information' have been analysed in depth; others, like the implications of the word 'technology' have necessarily been left aside. The point about the use of non-educational analogies and models in educational discourse has been raised at the end because it is felt that educational technologists must be aware of what they are doing. The means of instruction — in this case, information retrieval systems — are likely to affect educational ends if only by linking educational discourse with some
other area of discourse, in this case, communication and information retrieval.

Perry\(^{21}\) has pointed out the advantages of such transfers; they can provide a new way of conceptualising a problem which might not have occurred if metaphors and models had been strictly avoided. Kneller\(^{22}\) quoted in the introduction, has emphasized the importance of distinguishing between different contexts, and this must act as a check on oversimplified analogies. A person who approaches educational problems from a primarily linguistic standpoint, is likely to be open to both the possibilities and the dangers of analogical thinking. From what has been said in the preceding chapters, it should be clear that the attempt here has not been to equate information retrieval and instruction, but to use what seems transferable in the first field to help achieve ends in the second. It would not have been possible to make this transfer satisfactorily without in the first place arriving at a definition of instruction in terms of the systematic design of teaching, since the limits of the transfer would not have been clear. The definition of instruction in terms of systems\(^{23}\) provides the context within which analogies can be safely and productively used.
REFERENCES TO CHAPTER TEN


4. ibid.

5. CHRISTENSEN, C.M. and STORDHOLM, K.E., art.cit.

6. HORN, R.E., op.cit.


9. ibid., p.iii.


19. ibid.

20. LUMSDAINE, A.A., op.cit.


23. VERNER, C. and BOOTH, A., see Chapter One, references 9 and 10.
APPENDIX A

EXTRACT FROM 'ADULT EDUCATION FOR DEVELOPING COUNTRIES'

PROSSER, R., Adult Education for Developing Countries (Nairobi, 1967), pp.110-129.
EDUCATIONAL RADIO AND TELEVISION

One of the major problems which faces adult educationists in Africa is that of reaching the mass of the people. Africa is by no means, in comparison with other parts of the world, a densely populated continent. The areas are large and, with exceptions, the people are thinly spread over them. In urban areas it is possible to collect homogeneous adult groups together to make face-to-face teaching methods worthwhile and economic, although even in this situation the demand for education often outweighs the supply of adequately qualified teachers. But what of the rural areas over which the bulk of the population is scattered? Radio and television can help to provide a solution. They can be used for teaching purposes in town and cities, but they are often the only way in which adult teaching can be achieved in rural areas.

The full effect of teaching using radio and television in Africa is only gradually being realized. But these are the media which are becoming more and more popular in providing general educational opportunities and as familiarity with their use improves, new ways of using them are devised. It is possible that these media in the near future will take the brunt of the educational burden.

It is because those working in adult education will find themselves using these media more and more that this chapter is justified. They will be responsible for devising programmes, for introducing programmes, for conducting programmes and, at the receiving end, controlling listening and viewing groups.

Along with the problem of providing for a scattered adult population is the problem which faces all developing countries; that of the shortage of trained and skilled teachers. Again radio and television provide the means which can help to overcome this. One good teacher can, through radio and television, teach at any one time many people scattered over the country, both children and adults. As there seems to be no likelihood of the teacher shortage solving itself, these media must be fully utilized.

It is true, and no doubt will remain true for some time, that radio and television coverage is limited. This is more so of television than radio. It is also true that costs of receiving equipment are high. Yet a growing number of African countries are providing television services and communal television sets. All have radio services and most adults have access to a radio set. Coverage is increasing all the time and as good educational programmes are available, so the demand for them will grow.

In this chapter radio and television will be examined in turn: their advantages and disadvantages examined; major difficulties in the preparation and transmission of programmes looked at; and finally some suggestions of the most effective ways in which these media can be used in adult education.
Radio

The advantages of using radio as an educational medium include:

1. It can reach a wide audience, over as wide a distance as reception will allow.
2. It is economic for material can be prepared and recorded and used as many times as required. Thus repeats become cheap and possible.
3. Receiving sets are readily available and reasonably cheap.
4. The best teachers can be used with a very wide coverage.
5. The programmes can be heard inside the home if necessary, thus making them more convenient.
6. With the introduction of transistorized radios, sets are easily transportable.
7. Programmes can be used as complete teaching courses, or can be integrated into face-to-face teaching courses, or used in conjunction with correspondence courses.

But there are disadvantages and these must be considered by those responsible for planning and administration of programmes. They include:

1. Radio can be impersonal and students listening for long to a voice from a box can lose interest quickly.
2. There can normally be no student feedback which is spontaneous although the use of listening groups and correspondence courses can help to overcome this disadvantage.
3. Radio programmes can provide no visual help and therefore there is a limitation on the variety of subjects which can be taught.
4. Radio programme reception can be interrupted thus causing loss of continuity.
5. Lengthy regular radio programmes unsupported in other ways cause difficulties of self discipline amongst students.
6. Because radio programmes are beamed to a large audience and "anybody" may be listening in, there is often an initial reluctance on the part of tutors who have had little experience of the medium to commit themselves to the radio.

Types of programmes

It is useful to distinguish two different types of educational broadcasts. The first type includes the general interest programme which is beamed out at the general public.
These would include news items and commentaries and programmes which have an entertainment content which is more important than the actual educational content, eg discussions, quizzes, forums. The second type is the educational broadcast of an high educational content which is beamed at a specific audience. These include schools broadcasts for children and broadcasts for farmers, school teachers, engineers or any other specific group. These programmes, while being mainly for educational purposes may also entertain and should do so for best effect.

The general interest programme involves problems of planning, content and evaluation. Experience and listener surveys are two ways in which a guide can be found to the most popular types of general interest programmes. Experimentation with new ideas involves a certain amount of risk which must be carried out if new forms are to be popularized. Evaluation is difficult since there is generally no feedback and the only guides are periodic listener surveys which assess popularity of programmes.

Strictly educational broadcasts can be used in all forms of adult education. As has been suggested, their use in developing countries is one of the few ways in which any real impact can be made on their large scale problem of adult educational provision. Educational broadcasts cannot stand on their own. But they can be usefully integrated into correspondence courses and regular class meetings.

Correspondence courses alone are very impersonal and for successful completion require a high degree of self-discipline. Regular radio broadcasts can inject a more human element and provide a stimulus to regular student study when built into a correspondence instructional system.

In rural areas especially, regular and frequent face-to-face classes are difficult to organise through lack of teachers and the often thin scatter of students for higher level classes. Regular monthly weekend sessions may be all that can be programmed realistically. However, educational radio broadcasts can again be used providing continuity through the long periods when teacher and student cannot meet, with the added advantage of the best radio teachers being used.

Radio-vision — the use of radio with coloured filmstrips — is less effective than television, but nevertheless it provides a novel way of enlivening an educational broadcast and has proved attractive as a teaching method.

In developing countries where a low level of adult education has to be remedied speedily on a large scale, the use of the radio cannot be avoided. With imaginative and skilled forethought this medium of mass communication can be a cornerstone on which all types of large adult educational programmes can be mounted and carried successfully through.
Radio script writing

Many teachers of adults who are perfectly happy in a classroom hesitate before committing themselves to a radio broadcast. Radio broadcasting is an art and each broadcaster will use the medium as it best suits his personality. Nevertheless, there are a few guides which can help the new broadcaster and which he can use as a prop for his confidence. The following are a few which may help:

1. Never forget that any radio talk is for the ear and not the eye.
2. Remember that material must interest before it will educate so dress any talk in as interesting a manner as possible.
3. The audience is ONE person only, and, as in all adult education, never talk down to the listener—talk to him.
4. Do not try to teach too much at one go, concentrate on one or two major points and see that they are driven home in the most effective way. In formal subject lessons tell the student what you are going to say, say it and then tell him what you have said.
5. Make your delivery as personal as possible; write the script as you would say it; use shortened forms of words such as "shouldn't" instead of "should not"; use the active voice not passive, emphasize important words in the script.
6. Do not mind what the script looks like, it is the sound that matters.
7. Where there are listening groups, encourage them to take part, give very short questions which can be answered on the spot.
8. When quoting figures, round them off unless exact figures are absolutely necessary. In the latter case they should be repeated. Similarly, avoid lists. They are difficult, if not impossible, to assimilate by ear.
9. When the script is finished polish it up. Change dull words for more vivid and descriptive ones. Watch for word sounds which slur into each other when spoken and thus make comprehension difficult.
10. Time the script carefully and have a definite conclusion. Your speed of delivery should suit the audience to whom you are talking. Anything from 100 to 130 words a minute should provide a reasonable range guide.

Listening groups and feedback

Formal adult educational broadcasts will be beamed at a specific section of the adult community. In order to make the teaching more effective and provide a guide to student progress as well as creating a means of teaching evaluation,
some sort of student organization is required. The formation of listening groups is a way in which students can be brought together. The group can have a properly qualified teacher to amplify the radio teaching. If such a teacher is not available then a group leader who can conduct discussion and channel correspondence between the broadcasting agency and the students could be obtained.

Listening groups provide a number of elements which are often essential to making the best use of broadcast programmes:

- they make possible the use of communal radio sets where such sets are not available to all students;
- they enhance and provide an extra self-disciplinary aid to students studying privately and individually.

The group meeting can itself encourage student application from its social nature;

- they encourage the exchange of ideas on the teaching content between students and provide opportunities for face-to-face teaching if there is a teacher available. Difficulties can be cleared up easily and the subject or topic of the broadcast developed further within the group.

More important, they provide a way of evaluating the broadcast courses from the feedback from individual students and teachers or group leaders. General comments sent in, questionnaires and problem-answer papers submitted will allow the radio teacher to know how successful he is, and indicate ways in which he can improve his performance. A national structure of viewing groups will give a guide to national response and provide an organizational framework through which teaching materials can be distributed, new programmes advertised and written work marked and assessed.

**Television**

Television is proving to be one of the most versatile audio-visual aids ever developed. Educational television is a relatively new field of activity and there is still a great deal of experimentation to be done to develop its use to the full. Much of what has been written about radio applies equally well to television. Radio has many advantages as a medium of mass communication, but in some ways television has even more.

Television appeals to the eye as well as the ear. Therefore, a much wider range of subjects can be taught than by radio and a wider range of teaching methods and aids can be used. Teaching by demonstration makes effective instruction in the applied and physical sciences possible. "Live" commentaries and the use of visual aids enlivens all teaching.
While much can be said for television, it is as well from the outset to bear in mind some of its deficiencies. It cannot do all. It can never replace face-to-face classroom teaching for it lacks the personal touch of teacher and student. The spontaneous friendly comment which stimulates and encourages the learning process in the classroom or group session is missing. The cut and thrust of quickfire questions and answers which makes for good teaching cannot be reproduced. The pace of teaching is fixed and can proceed neither slower nor faster than the machine. Of course, some of these disadvantages are overcome when the television programme is supplemented by some face-to-face teaching and, as sometimes happens, are integrated into correspondence course instruction which also includes periods of face-to-face meetings. There are wide varieties of instructional programmes which can be devised based on the use of different educational media including television.

In developing countries, the use of television can be a tremendous aid to the provision of adult education programmes. Yet care must be taken that a national television service does not become a mere status symbol as a sign of national development, without due regard to quality of programme. The influx of cheap poor quality entertainment programmes of a strictly commercial nature is to be regretted when it is allowed to the extent of taking up viewing time which could be used for more constructive purposes.

It is common to hear two distinct types of television discussed. These are open circuit television and closed circuit television.

Open circuit television is the kind of television which brings the normal daily programme. Anyone within the area of the waves, with a standard receiving set, can normally tune in to the broadcasts. It will generally be on open circuit television that mass adult education programmes will be presented, since it has a wide coverage. Programmes may range from strict entertainment, through a mixture of education and entertainment, to programmes mainly intended for educational purposes. As far as adults are concerned, it is unfortunate that the most convenient times for adult educational broadcasts corresponds with the times for peak entertainment demands - evenings and weekends. Even so, there is much that can be achieved if adult education time is allocated in the early evenings and Sunday mornings when demand for pure entertainment is likely to be lower. Of course, no problem arises when a separate channel can be devoted entirely to educational purposes.
Closed circuit television provides broadcasts to a limited area in such a way that conventional receiving sets cannot pick up the programmes. The term may apply to anything from small inter-classroom systems embracing a number of schools or buildings in an area. Closed circuit television is cheaper than the open circuit variety and can be privately devised. It is useful in relaying programmes, economically, within a small area.

In the arrangement of adult educational television broadcasts, the problems which will be faced can be considered under three headings: technical problems, teaching problems and organisational problems.

Technical problems

Television is a technical medium; skilled direction, the production of competent camera work and precision timing are but three key factors in obtaining the best presentation. Most teachers will not have the knowledge and skills necessary and they will need the help of an experienced television director in the production of the programme. Successful programmes will be those which have a maximum of mutual understanding between the teacher and the director. The director must be able to communicate his understanding of the ways and methods of television to the teacher. However, he must also understand the problems of the teacher in organizing subject matter and keeping the students' interest. It is advantageous if the programme director has previously been a teacher himself, and the more teachers who are trained in the intricacies of the mechanics of television production, the better.

At the very early stages of planning an educational television series, it is essential that teacher and director get together, so that the programmes can be devised jointly and with harmony.

Teaching problems

Once the subject has been settled and the limits set, the number of individual programmes in the series can be worked out and the topics assigned to each.

Points to remember in the preparation of individual programmes on the transmitting side are:

1. Television is a visual medium. If a programme does not have a strong visual appeal, it should be produced over radio.

2. Everything that goes before the television must be planned.
3. Use, whenever possible, simple non-technical language and try to speak normally. Correct mistakes without undue worry and with grace. Mistakes will occur.

4. Do not overdo visual aids, the skilled teacher will use them as an aid and not as an end in themselves.

5. Keep persons involved in any one broadcast to a minimum.

6. In general, it is better not to have a script. An outline of sequences of events and cues is often sufficient, and dialogue can be improvised. Programmes should be rehearsed but again it is only necessary to fix the sequence of events and cues.

7. Marshall all the necessary visual aids well before the programme begins.

8. In timing, it is better to finish a little early than rush the last few minutes.

9. Plan well ahead and keep programmes in hand to avoid last minute rushes.

Points to remember on the receiving side for those working with viewing groups:

A. Prepare the room thoroughly, check lighting, ventilation, seating and the position and efficiency of the machine.

B. Prepare the student for the programme. The student should be fully aware of what the programme is about and why it is being viewed.

C. Encourage, students, if necessary, to take notes whilst the programmes are running but see that they are kept brief so that the student does not miss important parts of the programme.

D. Be as prepared as you can for technical breakdowns and bad reception. These do happen. Have something in reserve.

E. Follow-up is important. Discuss the programme with the students, explain difficult points, elaborate where necessary and summarize.
Organizational problems

The costs of providing television services are high, the costs of receiving sets to viewers are high, therefore to be economic there must be a mass student audience. With a large enough student body, television education is economic. It has been proved so many times. But because large numbers and large areas are involved, organizational problems are correspondingly large.

Television in its most effective usage entails a complexity of relationships: its integration with other media, the broadcaster and viewers, the technicians and teachers. To make full use of television services requires a national organizational structure which brings together technicians, teachers and administrators. A separate chapter has been devoted to general organizational problems, it is sufficient here to provide a cautionary word and to emphasize the need for such an organization, before television on an open circuit can be made to play an economic role in the provision of adult education, for it is an expensive medium to play with.

Television has a major role to play in all fields of adult education. In formal adult education integrated with correspondence courses and classroom teaching, it can bring the best teachers into contact with adult students and provide a major breakthrough, where national school systems leave a large uncatereed-for youth and adult strata. In fundamental adult education, television can teach literacy and teach non-readers useful information in the fields of agriculture, health, and child care amongst other subjects. In liberal adult education, through discussion programmes, news items and general courses, it is a stimulating aid to developing a thinking and discriminating adult community. In developing countries, it must be used.
CORRESPONDENCE, EDUCATIONAL

PROGRAMMING AND TEACHING MACHINES

One advantage of late development is that the newcomer can make immediate use of the latest knowledge, techniques and devices made known by others without having to go through the laborious expensive processes of trial and error and experimentation. Developing nations just beginning to grapple with the problems of large scale adult education provision can similarly take advantage of new methods and skills devised elsewhere in the field of adult education.

Adult education by correspondence is not only new to the world, but it is relatively new as a home grown form to the African continent. The value of such an educational method is being rapidly appreciated and is taking on a new importance. Adult educators must be prepared to take part in such developments and must, therefore, acquaint themselves with the details of the skills and disciplines associated with this method and which are basic to their successful implementation.

The use of programming alongside the development of teaching machines is comparatively new to the world. Both programming and teaching machines are on the frontiers of the development of a new educational technology with prospects of revolutionary conventional educational methods. Adult educators must be aware of them and be in a position to assess their importance and make use of them, adapting to local requirements as circumstances permit.

Adult Education by correspondence

Education by correspondence making home study possible has been impressively developed in such diverse parts of the world as America and Canada, Australia, New Zealand and Scandinavia. In Africa, the educational traditions of the ex-colonial powers did nothing to encourage the growth of this type of educational method. It is only in recent years, that new national governments have made any significant attempts to remedy this situation and as part of government policy to use it as an effective weapon in providing mass education.

Yet it would be wrong to assume that there has been no education by correspondence. Commercial correspondence schools have been active for many years and these, for many adults, have provided the only opportunities for educational advancement. Most commercial correspondence schools have been based overseas but a few are local. As in any other field of commercial education, some schools give value for money, others do not. However, such is the scale of educational need that it is now becoming impossible for ministries of education, universities and other public bodies of adult education to avoid involvement in the provision of correspondence education and to provide courses on a non-profit making basis.
The advantages

Correspondence courses can be evaluated in their own right or they can be considered as an integrated element of an instructing system involving their use alongside other teaching methods. Thus, they can bear the complete teaching responsibility for certain types of courses, or integrated with radio or television courses, residential courses or part-time face-to-face classes, they can bear partial responsibility for many other varieties of instructional courses.

They have a number of advantages:

1. They can provide a cheap but practical way of educating a wide range of adults who cannot attend, or do not have the opportunity of attending, regular classes.

2. They can provide effective teaching in a wide range of subjects especially in the formal arts field and with the integration of periods of student residence, a limitless range of subjects.

3. Their instruction is individual, teacher to student, and each student can move at his own pace.

4. They can provide thorough teaching in that the student moves systematically through a field of study going on to new material only when the previous is mastered.

5. They can provide the best teaching material to a wide range of students since quality control is centralized.

6. Courses can begin at any time; there is no need to wait for new terms except where supervised group meetings are an integrated part of the course.

7. They allow education to continue while adults are working and earning, thus in no way interfering with individual incomes and national efficiency.

The disadvantages

1. In subjects requiring a large degree of group participation or demonstration, unless taught in conjunction with other teaching forms, they cannot be fully effective.
2. They require students who have a great enthusiasm for learning, since the self-discipline required to carry through a correspondence course to successful completion is great. Again, other stimuli alongside, such as regular radio/television programmes and residential periods, can keep the student up to the mark and help to remove this disadvantage.

3. They require an efficient postal system with as close a network of mail receiving and distributing centres as possible.

4. They require a high degree of organization to maintain high standards in the preparation of material, in the controlling of finance, on the efficient distribution and collection of work assignments and in marking. Where other media are involved as well, an even higher degree of organization is necessary though not unattainable.

**Organization and costs**

The two major functions which organization will serve, will be administrative and academic.

The Administrative functions will include: the development of routines for publicity, fee collection and enrolment of students, duplication of materials, despatch of materials, collection of completed assignments, distribution to and collection of assignments from markers, return of marked assignments to students, maintenance of student records, general cataloguing, and the general student advisory service.

The Academic functions will include policy-making on the types of courses to be prepared, preparation and renewal of courses, preparation of ancillary services i.e., text books and book lists, planning of any integration with other teaching forms such as radio/television, residential courses etc.

Top management will, of course, combine the chief administrative and academic functions and will be responsible for policy-making and liaison with other national planning bodies to ensure maximum co-ordination within the general scheme of provisioning for national needs. This means that the director of a correspondence unit must be both a tutor and an administrator.
A general correspondence structure

The costs and economic viability of a national programme of correspondence education will vary with the size of the market and the ability of students to pay. It is thus difficult to generalize. It is normally true, however, that the larger the student market, the cheaper the cost per student, and correspondence plays its part most effectively as an instrument of mass education. While the costs of equipment, permanent staff and programme preparation will be spread more thinly as the number of students increase, costs of postage, marking (if part-time markers are used), and stationery will increase proportionately and can be a high proportion of total costs. The use of marking machines with programmed material can help to keep costs down. Nevertheless, correspondence education is normally a cheap form of education which at the same time can achieve first class results and in developing countries with scattered populations may be the only way in which any serious attempt can be made to provide either child or adult education.

Course writing and student needs

Any correspondence course will only be as good as the material in it. The writing of a course will require careful thought and preparation. Classroom teaching allows for margins of incoherence and wandering: a correspondence course does not. The writer must be an expert in his subject but must also be an expert on learning methods. He must understand how a student learns on his own. He must understand the nature of the general student who is to use his material. He must, from the outset, clearly define his objectives, only then can be decided on the relevancy of the material he will use. The arrangement of the material, the inclusion of illustrations and the illustrations and the preparation of written work must be devised to make learning as easy as possible for the student, and written and presented in such a way that the students' interest is maintained throughout.

Skill in writing correspondence courses will come with practice and the completion of a course should never mark the end. Constant revision will be required to keep the material up to date, to improve presentation and to ensure that only the best is provided. Only the best is good enough for students who have the courage to study on their own.

Organizations offering correspondence courses, whether commercial or non-profit making have a special responsibility towards their potential students. Besides offering only the best they must be sure that the student is ready for the course. The student must have sufficient educational background to be able to benefit from the course. He must have the necessary ability to do the work properly. He must have sufficient incentive and self-discipline to complete the course.
He must be prepared to set aside enough time to study properly.

In developing countries, such is often the thirst for education and so few the opportunities that correspondence school is never short of students. Where such a situation exists the unscrupulous will move in. Adult educators must be in a position to advise potential adult students of the best schools which can meet their needs; they must also be able to advise them against the worst.

Programming and teaching machines

An exciting development in the general field of education over recent years is the introduction of the techniques of programmed learning and the use of teaching machines. This development is still in the experimental stage but results are proving encouraging and there is every likelihood that in the near future both the technique and the machines will become widespread. All concerned with adult education will need to keep themselves abreast of these innovations and understand the basic principles of their use.

Programmed learning or more grandly, auto-instructional materials as it is sometimes called, has grown up with the development of psychology and it has been applied to education and the process of learning. Most educators agree that the basic principles of learning are:

1. When a student learns, he learns for himself. A teacher may stimulate him to learn and provide him with materials but it is the student who does the job.
2. The rate at which a student learns varies considerably, and students learn best at their own pace.
3. Complete mastery of each step makes total learning more effective.
4. A student learns more when each step is underlined.
5. When a student learns on his own, he is likely to learn more.
6. Whatever a student has to learn should be appropriate to his background, and easily related by him to it.

Good programming is based on these principles, emphasizing each principle as much as possible. Programming means, basically, breaking down subject matter into small units of information which are then arranged in logical sequence.
The student works through the subject matter, unit by unit, on his own. The units of information, or frames, are presented in problem form and the student does not move from one unit to the next without first having arrived at the correct answer. In this way, at every step, his learning is underlined or reinforced. Depending on the design of the programme, problems usually require either filling in a blank space to complete a sentence or choosing the correct answer from a group of possible answers. Problems are not designed to catch the student out, but are rather designed to make it as easy as possible for him to get the correct answer; and a number of clues are often included in the information to achieve just this.

A simple example of two frames which could be taken from a programmed course in economics runs as follows:

(1) When the price of a commodity rises we expect the quantity demanded to fall.
When the price of a commodity falls we expect the quantity demanded to ......

(2) If the proportionate increase in the amount demanded of a commodity is less than the proportionate increase in its price we say that the demand for that commodity is inelastic. If the proportionate increase in the amount demanded is greater than the proportionate increase in price we say that its demand is ......

The response to frame (1) is clearly "rise", to frame (2) "inelastic". Cues are obvious in both frames and it is made as easy as possible for the student to reach the correct answer. He will learn as he is responding and making a correct response will reinforce his learning. Answers are provided and the student checks himself, before moving to the next frame.

This type is called Linear Programming since the flow of information and frames moves directly forward in a straight line.

**Diagrammatic Representation of Linear Programming**

[Diagram showing linear progression of frames]
A second type of programming is called **Branch Programming** which has more flexibility than linear programming in that the material can adjust itself to the student's response. The same pattern of unit frames is used for both, but in branch programming multiple choice questions are offered. If the student chooses a wrong answer then he is told that he is wrong and may be directed through a new remedial sequence of frames before rejoining the main sequence.

Branch programming has the advantage that the quicker student can proceed without losing interest, and the slower students who are prone to mistakes can be led off on branches where they will be provided with more fundamental and simple instruction. One argument against the use of branch programming, or rather against multiple choice test questions is that presenting a correct answer amongst a number of wrong answers may cause the student to remember a wrong answer which might otherwise not have occurred to him.

**Diagrammatic Representation of Branch Programming**
Teaching machines

Teaching machines vary from programmed text books to complex and expensive electric computers. They are used in conjunction with courses of programmed learning and naturally it is the quality of the programmed material which is basic to the success of the machine.

The advantages of such machines are fourfold:

1. They allow the student to work alone.
2. They make sure that the student understands each unit of information before he is allowed to proceed to the next.
3. They present only one unit of information at a time, and the student proceeds at his own pace.
4. They help the student to maintain interest by making him respond and presenting him immediately with the correct response.

The simplest teaching machine is the programmed text book. The book presents programmed subject matter in generally a linear or a simple branched flow. After responding to a frame, the student is directed to another page for the correct response, or he may have the correct response indicated by the side of the following frame which will be expected to be kept covered until he has answered. Of course, this type of book may tempt students to cheat which is not generally possible with mechanical teaching machines. Nevertheless, well constructed programmed books can be a great help to a student studying by himself who is prepared to use them correctly.

The simplest mechanical teaching machine has the programmed material in reel or disc form, placed in the machine with one frame appearing through a window in the machine. A separate window exposes a space for the student to make his response. After making his response, the student turns a handle which produced the next frame and the correct response. At the same time, his own response will have moved on under a transparent cover which allows him to check his response against the correct one but does not allow him to make any alterations. In this way, he moves through the complete programme. When he has finished, he will repeat it, but a simple mechanical device will cause the machine to present only those frames to which he gave an incorrect response.

Complicated electrically operated machines allow for great flexibility and can present linear or branched sequences with multiple choice questions. They are expensive and their development is still largely experimental.
This brief and inadequate introduction to programming and the use of teaching machines is meant to indicate to the adult educator the basic rudiments of a new educational technology. There is no doubt that in a situation where there is a chronic shortage of teachers and insufficient and poor resources and facilities, it has much to offer and can play a great part in improving the quantity of all forms of adult education in the developing areas of the world. Its use should not be devoted solely to child education and need not be a monopoly of those countries where it has originated. Good programming requires skill in presentation as well as a thorough knowledge of subject materials; it is based on the learning processes of those students for whom it is intended; cheap machines can be devised to suit local needs. Adult educators in Africa, who know Africa, are the ones who can best produce materials for Africa. They must enter this technological field.
References for all chapters, including the introduction, and other bibliographic items have been collected here alphabetically by author. The list is divided into five sections:

1) Main References.
2) Secondary References.
3) Bibliography: published items.
4) Bibliography: unpublished items.
5) Journals

Most of the items are available in the libraries of the Department of Adult Education and Extramural Studies, University of Sussex, the Centre for Educational Technology, University of Sussex, or the main libraries of those universities. In a few cases, the library of the Institute of Education, London, has been used. Comments on the main references have been made in the Introduction.

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5. Journals

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